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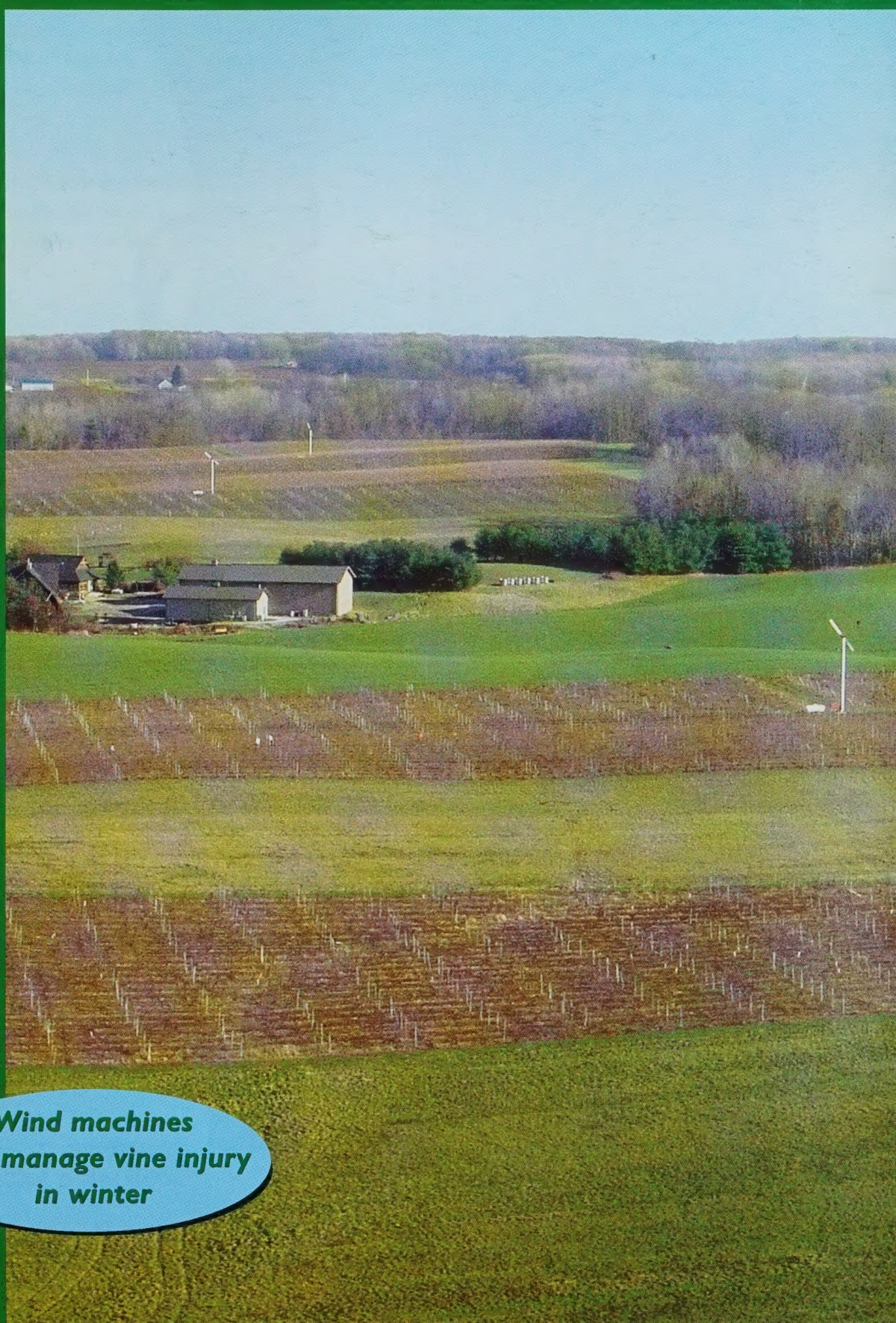

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PRACTICAL WINERY & VINEYARD (ISSN 9739-8077) is owned and published by PWV Incorporated. Published bi-monthly at subscription rate of $31/year. Outside the United States, please add $10US, sea mail; $18US, air mail. Postmaster: Please send change of address to 58-D Paul Drive, San Rafael, CA 94903. Back issues: $5 prepaid. News media may use no more than 1/4 page of material per issue provided that PRACTICAL WINERY & VINEYARD is credited.

PRACTICAL WINERY & VINEYARD

MARCH/APRIL 2006 • VOL. XXVIII, NO. 1

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Record-keeping requirements for FDA Bioterrorism Act

BY Doug Campbell, eSkye Solutions

Less than a year after the destruction of the World Trade Center on September 11, 2001, Congress passed The Bioterrorism Act of 2002, which was designed to protect the public's health, including the safety and security of the nation's food supply, among other provisions. As producers of a food substance, wineries must comply with the new, tougher reporting requirements imposed by the Bioterrorism Act. The federal Food & Drug Administration (FDA) is the administering body.

Bioterrorism reporting: What are the requirements?

The final bioterrorism reporting rules were released in December 2004. All wineries must comply *unless* both of the following conditions are met: They have less than 11 full-time equivalent employees (FTE), and they sell more than 50% of their product directly to consumers out of their facility. (An FTE is one full year of full-time work, or 2,080 hours.)

The largest wineries (more than 500 FTEs) had to be in compliance by December 9, 2005; medium size wineries (more than 11 FTEs) must be in compliance by June 9, 2006; small wineries (less than 11 FTEs) must be in compliance by December 9, 2006.

What must be tracked?

Wineries are responsible to track any food product, food additive, or food contact substance in two ways. First, they must track the immediate previous source of the item (the company that supplied the item) and the transporter that delivered it. Second, they must track the immediate subsequent recipient of any food product and the transporter that delivered it. This covers receipt of grapes, juice, wine, additives, closures, glass, filtration media, and sale of juice, wine, and finished goods. The FDA requires that all products be tracked by lot number, if there is a lot number on that item.

What does not have to be tracked?

Any additions done in the vineyard need not be tracked because vineyards are not covered under the FDA rules. Also, any packaging materials that do not touch the final product (such as labels and shippers) do not require tracking.

Gray areas

Because some of the processes that wineries use are very different than those of most food producers, and because these unique processes raise some questions that have not been explicitly spelled out, there are some gray areas that will need to be dealt with.

The first gray area has to do with barrels. Regulations clearly state that food contact substances that are not part of the final product do not need to be tracked (this would include tanks, pumps, piping, and barrels). However, at the Wine Industry Technology Symposium (WITS) held in Napa, CA (July, 2005), an FDA representative stated that barrels and oak additives should be tracked by lot-number if there is a lot number on the item. But when contacted for clarification, another FDA representative stated that barrels are contain-

The Tax and Trade Bureau (ATF/TTB) has always required wineries to keep accurate composition information and has audited wineries to guarantee compliance. By the end of 2006, the Food & Drug Administration (FDA) will require all wineries to do the same with all additives and any packaging that touch the final product. In addition, if an additive that the winery purchased is found to be contaminated, the FDA has the power to remove any wine that contains any of that contaminant. This can put your entire inventory at risk, especially if you can't prove which wines have that additive and which ones don't.

The bottom line is that wineries will be forced to keep better records. The FDA stresses that it does not intend, with this regulation, to place **undue** work upon wineries, or force them to change, in any great manner, current record-keeping procedures. However, detailed transactions of cellar additions, cellar movements, shipping, receiving and bottling will require more information than before and must be kept in a central location that is always **up-to-date**.

PWV invited Doug Campbell of eSkye Software to help instruct wineries on how to investigate the issue and reach compliance. Over the past 18 months, Campbell has met with wineries and FDA food compliance officials to discuss the issues and options facing wineries. Many wineries are already moving toward putting new procedures into place so that their transition will go smoothly and there won't be any surprises.

Where the FDA rules are unclear as yet, Campbell offers probable reporting guidelines.

ers that don't touch the final product, so they aren't covered.

The FDA has made it clear that their Bioterrorism regulations may be much different from any other federal or state compliance decisions. They are completely separate — therefore any prior decision on taxation has no effect on these new regulations.

Since most wineries are tracking barrels by lot number for winemaking purposes, it may be safest practice to also add these barrel lot numbers to your compliance paper trail or computer records.

Consequences of a contamination report

What can happen if the FDA contacts your winery about a contamination report? Any affected finished goods can be removed from the market and put in detention. The winery has 24 hours to tell the FDA what products were affected by the contaminant. This means that the winery must have a clear audit trail of what products are affected by this recall. The audit trail could lead back to a juice or wine that was purchased from another winery, an additive that the winery used in production, or a lot of closures or glass.

For example, if a specific lot of yeast was recalled, the winery would need to know all the blends that would have been affected by that yeast. Because of blending, this could affect several bottled products. Once the information is reported to the FDA, the winery can appeal within 10 days if it can provide proof that its product was not contaminated.

Transport information

New regulations require that more information be tracked regarding goods coming into and leaving a winery than the typical transporter bill of lading provides. Make sure that all the required information can be tracked easily (transporter name, phone numbers, and name of contact person). If required information is not on the bill of lading, it's the responsibility of the winery to make sure that data is obtained. In the event of a contamination report, it will be the winery's responsibility to provide all transporter information to the FDA.

Receiving items used in production

The first piece of information that the FDA would require in determining whether you took in a contaminated or "suspect" product, is anything that was added to the juice or wine, or any part of the packaging that touches the

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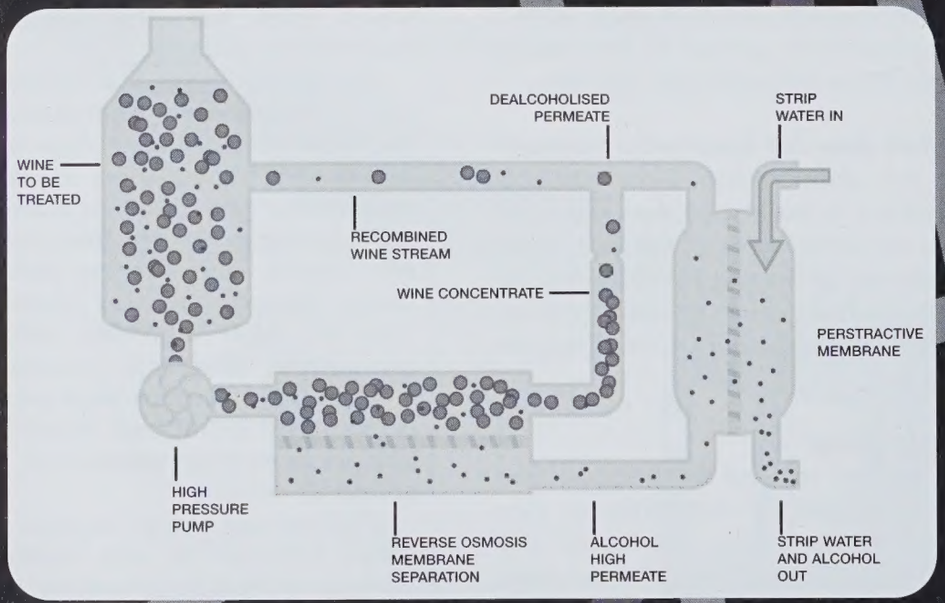

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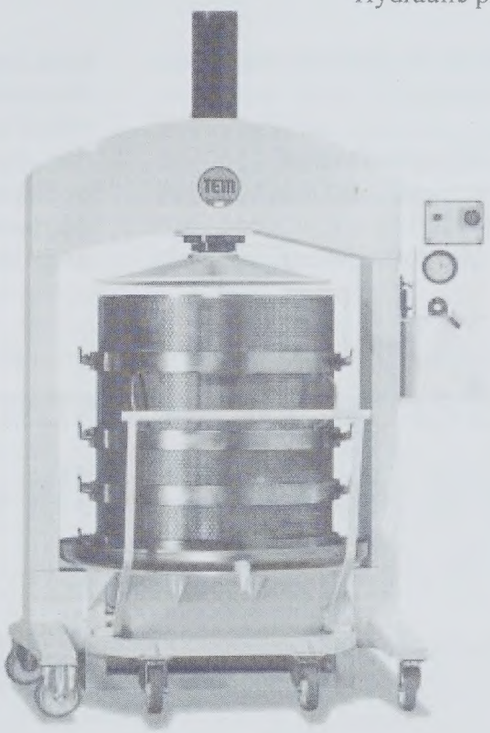

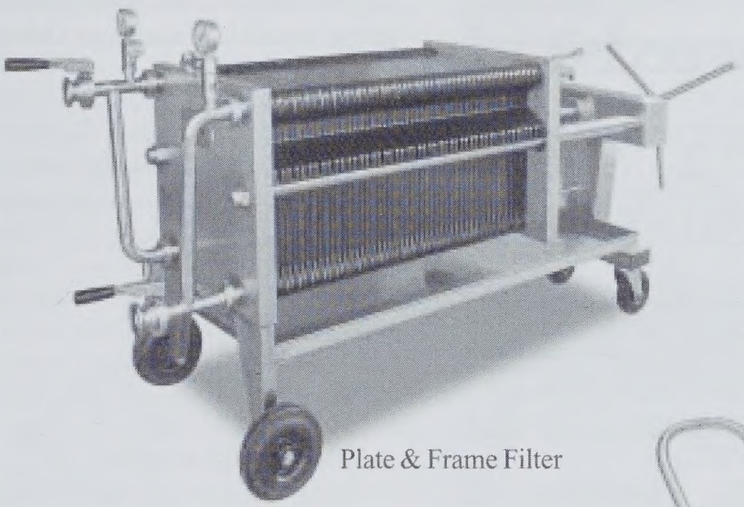

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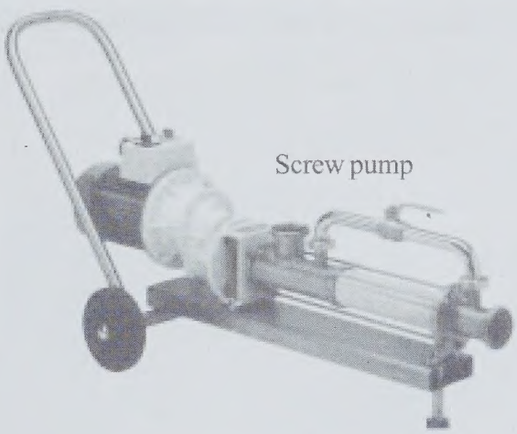

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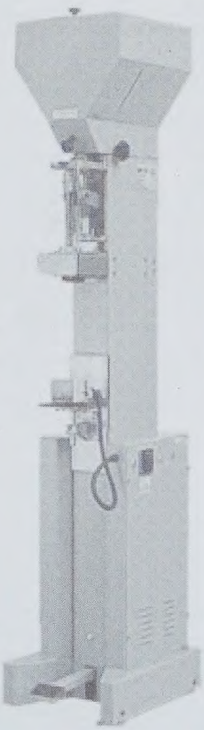

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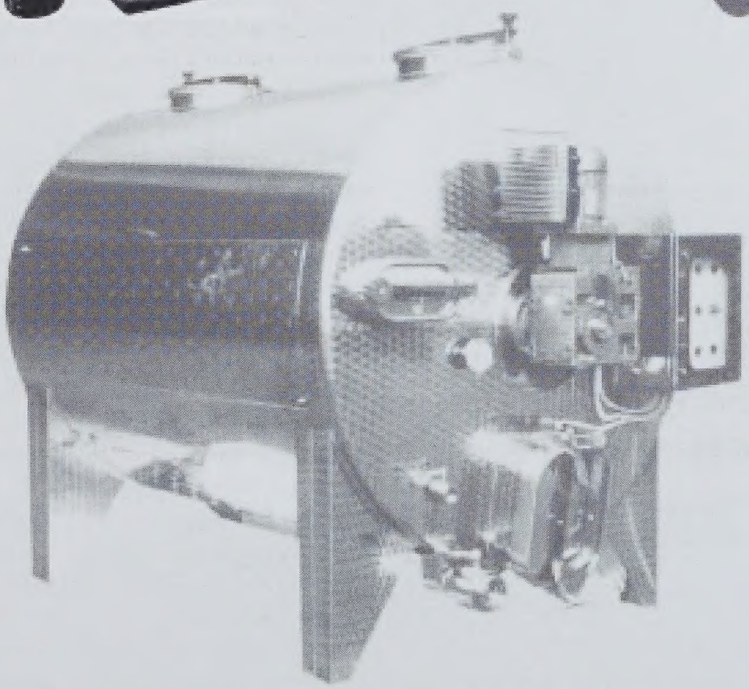

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Additives/dry goods used

At the very least, you must track all additions made to juice or wine. This will allow you to review which items have been added to which wine lots. However, unless you track each individual batch or lot number of the item (for example, you could have five packages of the same yeast that you purchased at different times and these could be from up to five different batches from a manufacturer), you don't have a detailed picture of exactly what happened to each wine lot.

Packaging materials

Any packaging materials that are directly in contact with the wine (such as corks and glass) must be tracked by batch, just like additives. As mentioned above, the FDA is unclear internally about barrels, so it is advisable to track barrel lots also.

Grape receiving

Each batch of grapes received must be individually identified and transport information (source of grapes and driver) must be recorded. If the FDA suspected something was contaminated, it would most likely use either a weight tag number or the date, vineyard, and transporter to identify a particular load.

Receiving juice or wine

Any juice or wine receipt must be accompanied by a bill of lading that would identify the product received. However, you must also make sure that all transport data is included. If the wine you're receiving happened to contain a contaminated item, the FDA must assume that you could potentially spread that contaminated wine to other wines in your cellar.

Shipping juice or wine

Any product that you ship to another winery must have a bill of lading identifying the product. In addition, the receiving winery is required to track the transporter that delivers that product, and will probably be required to provide information on the additives in that product from the shipper-winery.

Shipping bottled wine

Wineries are required to provide the additional transport information listed above [transporter, bill of lading, delivery person, all additives]. Also, you may want to consider putting more detailed information on each case of wine, as the bottling date may not be enough. Consider adding information to identify the wine lot,

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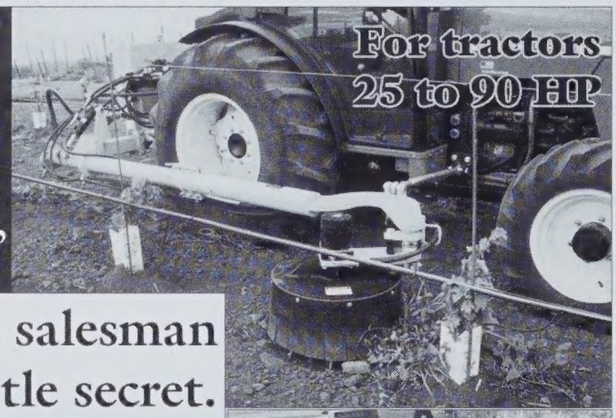

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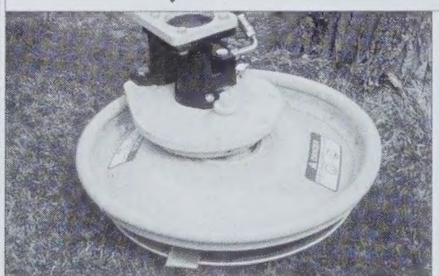

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the cork lot, and the batch of glass bottles used in producing each case of wine. Individual bottle coding may help.

Composition-tracking

Now more than ever, it is critical to accurately track the composition of each wine. Tracking what blends have been made with what components will be one of the major audit trails.

Centralized data storage

One significant requirement of this act is to force food producers to centralize their information storage so that quick retrieval of requested information is possible. You are required to respond with an answer within 24 hours of contamination notification from the FDA. This doesn't necessarily mean that the information has to be stored electronically, but if it's filed manually, it will have to be up-to-date and easily accessible.

Off-site storage

What happens if you must use another facility to temporarily store your unbottled wine? You will probably need

to give the facility all the additives that you use in-house, rather than risk use of untracked additives by the off-site facility that could contaminate your wine.

Solution options

Because of the complexities of wine production, it has always been a challenge to track all variables that may have had an impact on the final product. Detailed composition information, chemical analysis, what additives were used, what barrels were used, type of filtration used — the list of possible variables goes on and on.

Many wineries have used software programs to track all of these variables, while other wineries only track what the government requires. Until now, record keeping has focused more on taxation issues and justification for labeling. Now the bar has been raised to a level beyond what even the most detail-oriented wineries have been doing.

Because of the sheer magnitude of possible combinations involved in winemaking, software will play a larger role in winery operations. Those wineries that have existing software systems must insure that their vendor has addressed all of the above issues. In addition, the vendor should be able to provide a roadmap to help a winery get its procedures in line with reporting requirements.

If a winery does not have any software in place, this may be the time to take another look at existing software offerings. Several programs, on the market, address specific winery needs. You will want to make sure that the program not only addresses TTB requirements regarding composition and tax-class tracking, but also new FDA requirements. There are many other benefits to using software — it can help track cost of production, barrel ageing information, and asset usage, for example.

Not having an electronic system in place does not give you an excuse for non-compliance. Note that a "system" does not have to mean purchased software. Some wineries will choose to build their own system, using a spreadsheet or database or a manual filing system. But you will need some kind of system, and you will need to modify your procedures to achieve compliance.

The FDA states, "FDA believes that most of the information required by this regulation is currently collected as a matter of normal business practices, and that any changes to current business practices as a result of this final rule are small."

One simple example is that you will need transporter information on every additive that is delivered to

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your winery. You will have to train anyone who might receive goods (which could be someone in the tasting room) that he or she must record who delivered the goods and the lot number of the item, in addition to name of the item. This requirement may push you to designate only certain employees as receiving agents.

Another example is purchasing of additives. If you want to reduce your record keeping, you will want to make sure that your vendors don't send you three different lot numbers of a specific yeast when you order three packages. You may want to have all three packages from the same lot. (However, this practice could backfire as it may increase your risk if that lot number is the one that gets recalled.)

Finally, if you choose to track things manually, you need to remem-

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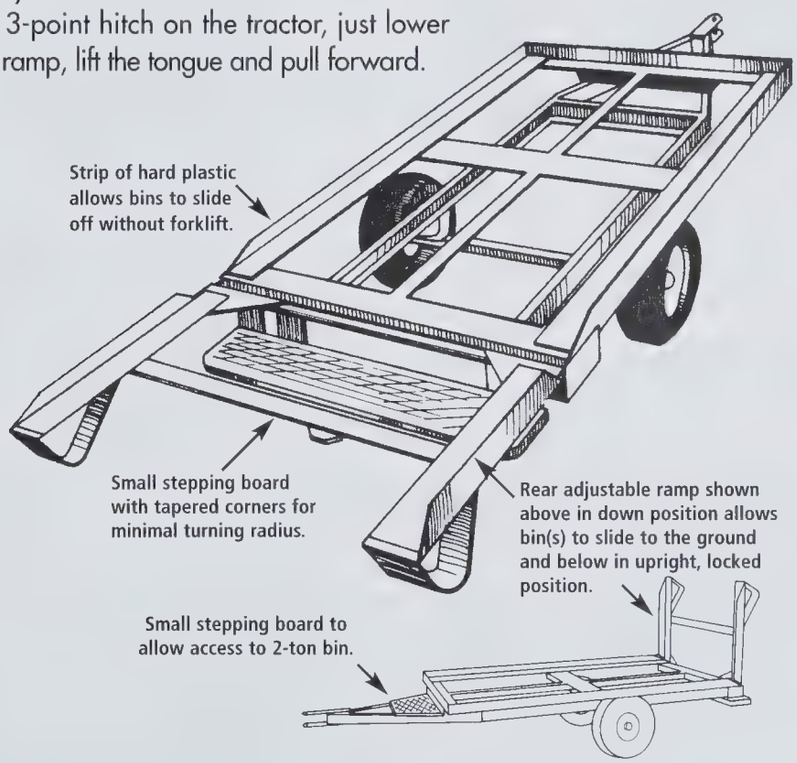
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ber the 24-hour reporting requirement. This means that those records must be filed in a manner that allows you to retrieve them quickly. I would also suggest that you institute frequent physical inventories and reconcile your inventory to what you think you've used. The biggest problem with manual systems occurs when someone forgets to write something down; physical inventory would help expose this.

Bottom Line

The bottom line is that the Bioterrorism Act will have a major impact on the U.S. wine industry. How you handle the new reporting requirements is really a question of risk management — how much risk are you willing to live with? You may choose to use one type of yeast instead of several and purchase it in larger quantities (and from one manufacturer's lot) to reduce record keeping, but again, if that particular lot of that yeast is recalled, you will have to recall all your wine.

If there's one thing I can guarantee, it is that these developments are raising a lot of debate in the wine industry. I have spoken to many eSkye Software customers, and there is no single best solution, and there are lots of opinions of just how far the wine industry will have to go in tracking things. My reply is that we should be prepared for the worst.

Wineries have had to deal with composition-tracking for the TTB for years, and this tracking is now accepted without question. If the TTB didn't require the detailed tracking by varietal, vintage, and appellation, would we have done it voluntarily? I doubt it. Wineries must spend a lot of time and money to track this information. In the same way, I believe that these new regulations will become standard operating procedures in the years to come. ■

[Doug Campbell is VP of Winery Systems at eSkye Software and has been involved in developing software solutions to the wine industry since 1989. Years ago, he created a software program called PC Blend that is still in operation today. That long-lived product led to the development of the Blend Suite of software that eSkye markets today. This software not only tracks wine production, but also vineyard operations, case goods inventory, sales, marketing, and distribution.]

Resources:

FDA website: www.fda.gov/oc/bioterrorism/bioact.html (see section 306 — Records Maintenance).

Wine Institute information: www.wineinstitute.org/bioterrorism/

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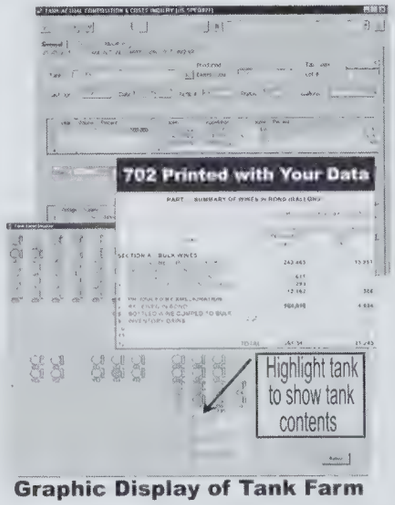

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Persistence of vegetal characters in winegrapes and wine

BY Kay Bogart, Linda Bisson,
Department of Enology & Viticulture
University of California, Davis

Researchers have gained more insight, in the last several years, into one of the main categories of compounds responsible for vegetal or herbaceous characters in some wines, chiefly the class of pyrazines that create the familiar green pepper/green bean aromas associated with many Bordeaux-type varieties.

Although these pyrazines, chiefly methoxypyrazines (MP), are not the only compounds responsible for many facets that define a grape or wine as "vegetal," they are the most common and the most well understood today. They may also act synergistically with other compounds to modify aroma and flavor in many different ways.

Below, we will summarize and present recent findings that will allow readers to gain a better understanding of what these pyrazines are and how they might be manipulated to meet specific quality standards or style considerations.

We have reviewed pertinent literature on the methoxypyrazines of grapes and the influence of viticultural and enological practices on their formation and stability as a starting point to address the persistence of vegetal characters in winegrapes and wine. Some results of a preliminary nature reported from France, New Zealand, and Oakville in Napa Valley are included. Such findings need to be evaluated under the reader's local growing conditions to determine what role, if any, they might play in the characteristics that define a wine as "vegetal."

It is important to clarify if we are, indeed, actually seeing the persistence of vegetal characters rather than a change in the definition of enological ripeness. Perhaps those characters that defined winegrapes as mature in the past may not be included in the current definition of maturity, but instead, may be indicators of a lack of ripeness. The characters or their evolution did not change, but the definition of what they represent may have changed. This is likely the case with pyrazines.

MPs are one of a group of pyrazines that are widely distributed in nature. In winegrapes, they are present in such small quantities that, until recently, their chemical detection and enumeration has been difficult. Their threshold in red wine, especially Cabernet Sauvignon, Cabernet Franc, and Merlot, has been reported to be as low as 10 to 15 parts per trillion.[1] But within the range of their occurrence, their aroma can be overpowering and unpleasant.

MP concentrations in wines have always shown a consistent relationship between winegrape variety and grape-growing conditions. Since MP concentrations are known to decrease during normal winegrape ripening, a high MP concentration in grapes at harvest has become commonly associated with a lack of ripeness and usually has a negative impact on wine aroma and flavor qualities.[2]

Because the fruit with vegetal characteristics is most often physiologically immature, there is often a corresponding lack of acceptable color development and an undesirable, harsh tannic quality in the wines produced from these grapes.

Winemaking decisions / methoxypyrazine content

It is important to understand how winemaking procedures may or may not impact the pyrazine content in a finished wine. In a recent published study, researchers in France were able to show that MP in grapes is highly extractable in the traditional winemaking process.[2]

MP concentration in Sauvignon Blanc wine was shown to be independent of pressing conditions of the juice. The final MP concentration in the Sauvignon Blanc wine, in this study, differed insignificantly from the first free run juice at pressing. Settling of the juice did, however, decrease MP content by almost half in the clarified portion. So, with white wines, settling may reduce grassy characters.

With Cabernet Sauvignon in the same study, all pyrazine, found in the wine after racking, had already been extracted from the grapes within 24 hours of crushing, before alcoholic fermentation began. This final pyrazine concentration in the wine was not affected by different cap management regimes or amount of time the wine spent on its skins.[2] This shows MP to be highly extractable in winegrape must.

Press wines, however, have been shown to contain higher levels of MP. This suggests that a fraction of MP remains in the skins and is extracted during rigorous pressing. In the same study, after ageing Cabernet Sauvignon for three years in a dark cellar, no significant change in MP content was recorded. Therefore, dependence on ageing or time in bottle to decrease vegetal character in wine is probably not an effective strategy.

An interesting observation from some researchers is that thermovinification of red grapes to promote extraction of phenolics and destroy oxidases also leads to a decrease in MP concentration in heat-treated wines.[1] The wines studied were heated to 60°C to 80°C for a short period of time. The resultant MP content was decreased to a concentration below the sensory threshold, so the original vegetal character was no longer perceptible.

In concurrent laboratory trials, MP was found to volatilize and dissipate into the headspace after heating to above 50°C. This could be useful in

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dealing with grapes that are harvested before optimal ripeness due to weather or growing conditions. Using thermovinification conservatively could, in certain cases, lead to more highly colored, fruity, less vegetal wines.

How vineyard decisions affect wine MP content

Since it can be shown that winemaking procedures probably have a minimal impact on pyrazine concentrations, it is most appropriate to focus on recent viticultural research for clarification on pyrazine management. This research seems to confirm that grape ripening conditions in the vineyard are primarily responsible for the methoxypyrazine content in wines.[1] This means that if your target wine style does not include a vegetal component, you will have to start your winemaking process very early by understanding what happens in the vineyard and how these compounds can be manipulated before harvest.

A very significant study, recently completed at the University of California, Davis, investigated the effects of yield manipulation through vine pruning and cluster thinning on the resultant sensory attributes and actual MP concentrations of Cabernet Sauvignon wines.[3] Researchers subjected vines to six different winter-pruning treatments and eight different cluster-thinning treatments; thinning being imposed at veraison.

This research is particularly significant because the large number of treatments resulted in an equally broad range of vine yields. In 2000 and 2001, vines were pruned to 12, 18, 24, 30, 36, or 48 buds per vine, with 24 buds per vine as the control. Separately, in 2001, vines were pruned to 24 or 48 buds per vine and clusters were removed at veraison to leave 12, 24, 36, or 48 clusters for the 24-bud vines and 48, 64, 72, and 96 clusters per vine for the 48-bud vines.

Yields ranged from 1.75 tons per acre to 9 tons per acre. In both experiments, treatments were imposed in a randomized complete block design with six replications. All wines were made in triplicate. Also, lending to importance of this research is the fact that researchers used trained judges employing descriptive analysis techniques to determine the sensory attributes of resultant wines.

Analysis of variance and principal component analysis showed that pruning vines to a very low bud number, produced wines that were perceived by the panel of judges to be higher in vegetal aroma and flavor, bell pepper aroma, bitterness, and astringency than wines from "high yield" vines.

Wines from vines that carried more crop (higher bud numbers) were consistently rated as higher in red/black berry aroma, jam aroma, fresh fruit aroma, and fruity flavor. Regression analysis showed that, in general, vege-

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tal attributes decreased in intensity and fruity attributes increased in intensity as bud number and yield increased.

In contrast, there were few differences detected in wines made from various cluster-thinning treatments, though the yield range was greater. They concluded that Cabernet Sauvignon aromas and flavors respond to yield manipulation, but do so significantly only when yield is manipulated early in fruit development (winter pruning, in this experiment).

This sensory evaluation was substantiated by a newly developed chemical analysis using a rapid and automated solid phase micro-extraction (SPME) stable isotope dilution gas chromatography/mass spectrometry (GC-MS) method for quantifying 2-methoxy-3-isobutylpyrazine (MP) concentrations in red wine. This assay showed that MP concentrations in wines studied were significantly negatively-correlated with number of buds per vine.[5] As bud numbers increased, MP concentrations decreased and, alternately, as bud numbers decreased, MP concentrations increased. In addition, MP concentration determined by GC-MS was directly related to sensory vegetal intensity ratings obtained by descriptive analysis.

The same study showed that crop thinning had a very limited effect on wine quality, though it obviously impacted yield significantly. These data are significant because they seem to challenge the paradigm that as winegrape yield increases, resultant Cabernet Sauvignon wine quality decreases. They further suggest that how the crop yield is attained, rather than the exact yield itself, is significant for resultant wine quality. This underscores the importance of determining proper balance for a given set of growing conditions as a function of the varietal, rather than having a pre-determined crop level that ignores vine performance at the site and overall grape composition.

Although the actual MP precursors have not been definitively determined, some important features of their synthesis and degradation are more clearly understood today. MP synthesis in grapes seems to occur between fruit set and two to three weeks prior to veraison.[2] This phenomenon seems to be related to grapevine water status before veraison, as initial pyrazine concentrations were less in drier years in France. At this pre-veraison stage, its concentration is highest in the stems. It is also found in the berry pre-veraison, but it is not known if it is actually synthesized in the berry or if it is synthesized elsewhere and transported to the berry.

MP has also been identified in Cabernet Sauvignon leaves, with basal leaves having the highest concentration, much higher than in clusters. About three weeks before veraison,

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MP content in berries decreases through to harvest.

Breakdown of malic acid and pyrazines seems to occur simultaneously in winegrapes, irrespective of soil type, grape variety, or vintage.[7] This very strong correlation in their respective concentrations may allow MP content to be considered a marker of grape immaturity. MPs may serve as a biological deterrent to consumption of the fruit before the seeds have attained sufficient ripeness to survive, and may indeed be directly linked to ripening. However, other explanations for the function of MPs have also been proposed.

Because the shape of the MP content-curve during ripening does not change as a function of how the units are expressed, it can be inferred that the decrease in MP content seen from about three weeks before veraison through to harvest is independent of the dilution that occurs during berry enlargement.[1] Therefore, unlike tartaric acid, MP is actually broken down as the berry swells and ripens.

Several studies have revealed a strong relationship between exposure to light and decrease in MP content to explain this decrease after mid-veraison. It is known that MP is broken down in the laboratory by light.[6] More work needs to be done in the vineyard on intact berries and clusters to determine if light is actually the chief agent of MP degradation. Regardless of phenological stage, the pulp contains very little MP while stems and older leaves contain a lot.[2]

At harvest in the cluster, MP is found mainly in the stems or rachis. It has been shown that, under identical environmental conditions, MP accumulates in leaves simultaneously with its degradation in grapes during ripening. All data, so far, suggests that metabolism of this pyrazine is completely different in grapes, stems, and leaves.[1]

Although actual quantification of MP content in grapes is not practical for most wineries today, it may be possible to track the curve of its degradation by monitoring the concurrent decrease in malic acid during ripening.

Recent research from France has shown that there is a significant correlation between degradation of MP content during grape ripening and loss of malic acid during the same period.[17] For the two years studied, Cabernet Sauvignon and Merlot grapes grown under different environmental and cultural conditions, were tested for both malic acid content and MP content from veraison to harvest. These data show that the breakdown of malic acid and MP occurred simultaneously, irrespective of soil type, grape variety, or vintage. The determination coefficient (r2) between the breakdown of these two compounds was 0.90 and 0.96 in 1996 and 0.91 and 0.99 in 1997. They are, therefore, highly correlated.

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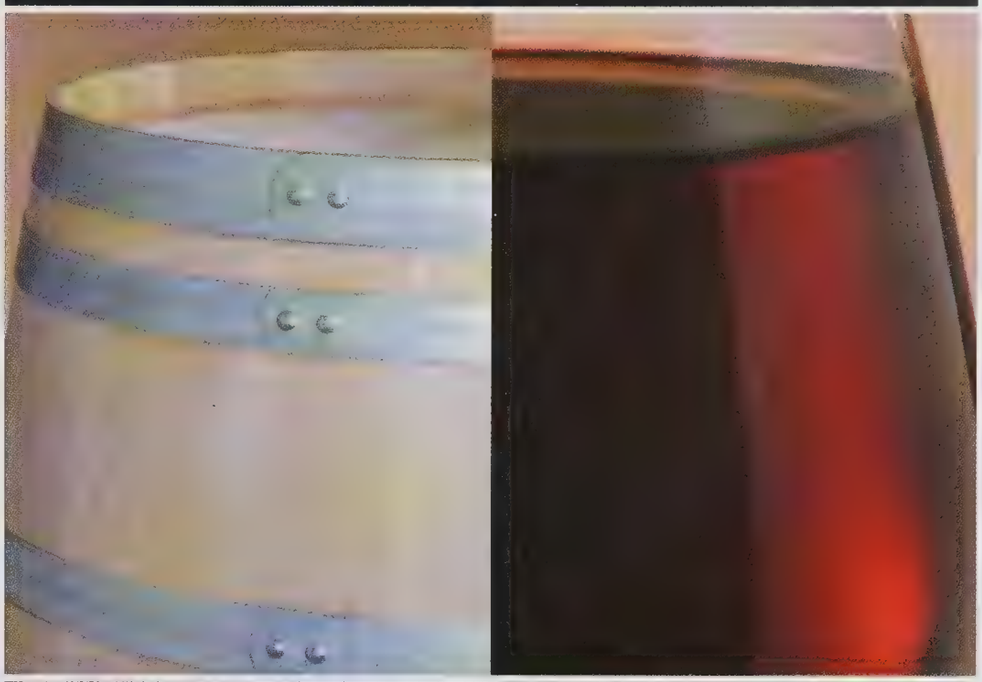

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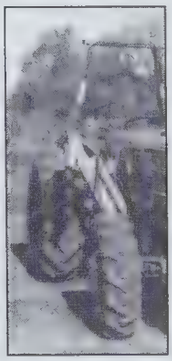
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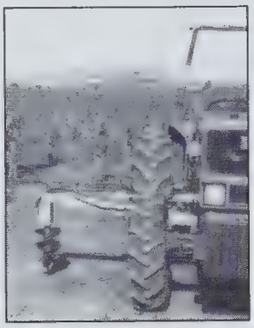
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ported to the berries, in a preliminary study (not yet published), researchers treated grape leaves with a solution of a marked analogue of MP by putting the solution on leaf blades, then analyzing its movement after several days.[1] This was done between the small pea stage and beginning of veraison.

Researchers observed a redistribution (movement) of the marked compound to petioles and other growing parts of the vine, including clusters. Amounts of MP confirmed the fact that, at this stage of ripeness, metabolites are preferentially routed to clusters. They found the marked MP in the rachis and berries, demonstrating that this compound is transported by the phloem from leaves to berries. Since it can be shown that MP is moved from leaves to the berries, this fact underscores the importance of managing vegetative growth to decrease the production of pyrazines. It is still unknown whether the berry actually synthesizes pyrazines itself or whether they are transported to the berry from the vine's vegetative structures.

These results confirm the advantages of leaf removal to decrease the perception of vegetal/green pepper characteristics. Another aspect of this research measured the effects of various canopy manipulation practices and their timing on the pyrazine content of Cabernet Sauvignon and Merlot grapes. Summer thinning of laterals, leaves, and clusters all had a direct effect on decreasing MP concentration in these two varieties.[1] The light-sensitive nature of MP may partially explain this result.

Wines made from cluster-thinned or leaf-thinned groups had higher alcohol, more color, and a lower MP content than those of the control. But timing of the vineyard work was also shown to be an important determinant of final MP content in the resultant wines.

Leaf thinning between fruit set and before veraison leads to grapes with a higher sugar content, smaller size, and less green pepper character at harvest. It is interesting to note that one year of the study in France, there was significant rainfall during veraison that greatly slowed the usual MP breakdown that occurs in this phase of berry ripening. This also resulted in an unusual heterogeneity in berry ripeness. The vineyard

had been leaf-thinned after fruit set, prior to the rains, so MP synthesis had already been inhibited somewhat.

Due to these lower levels of MP synthesis after leaf thinning and decreased breakdown due to rainfall during veraison, MP levels at harvest were close to zero. Comparing those results to a more typical year with less dramatic rainfall, the typical season showed much higher levels of MP at mid-veraison. These levels held through to harvest. This highlights the assertion that it is weather conditions just prior to and during veraison that most impact the final MP concentration in grapes, rather than the period between veraison and harvest.

Early lateral removal and leaf thinning also facilitate later season vineyard work by eliminating some vegetation in the fruiting zone. These practices improve vine balance, allow better light penetration , lead to better aeration around clusters, and remove vegetative structures requiring additional nutrients, which, in turn, promotes better distribution of photosynthates for improved ripening.[1]

Enological ripeness

Another aspect of the role of methoxypyrazines in wine production concerns the relatively recent practice of extended hang time of winegrapes to achieve more ripe flavors. There has been a great deal of speculation about the reasons and ramifications of this practice.

It is true that, from a winemaking perspective, the fruit of some varietals in some regions simply does continue to improve with extended ripening. In a study of Sauvignon Blanc in New Zealand, fruit grown in a warmer region (2100 heat summation units) had pyrazine levels below the threshold of detection while fruit from a much cooler region (1430 heat summation units) had a pyrazine level four-fold greater than the detection threshold at harvest.[5] This study is consistent with much earlier work stating that the loss of such "unripe" characters was the basis of recommendations of how varietals performed, or how they reached enological ripeness, as a function of degree day summation units.

As mentioned earlier, pyrazine characters have been shown to decrease with ripening, allowing a winemaker to time harvest to the appropriate level of vegetal character for the wine style being produced.

Some wine writers and consumers do not appreciate vegetal characters in wines, preferring instead wines of concentrated fruitiness. This preference has resulted in a trend towards extended ripening in an effort to further reduce vegetal character in winegrapes and to enhance wine fruit aroma profile. The efficacy of a particular grower or manager's program of extended ripening is predicated on the assumption that grapes are grown in an area that allows proper ripening.

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Today, such errors in judgment are rare, yet there is a belief that vegetal characters are persisting in the fruit much longer than they should based on other indices of ripeness or based on historical data obtained when most vines were planted to AxR1 rootstock. Many new vineyard practices were introduced simultaneously with extensive replanting of vines to rootstock other than AxR1.

Some of these practices resulted from extensive wine quality evaluation, although not necessarily broadly applicable beyond the region in which they were initially studied. But most studies simply evaluated vine growth parameters without benefit of accurate sensory evaluation of wines produced. Indeed, few were evaluated in combination, and changes in ripening of the scion varieties could simply reflect changes in vineyard practices.

However, it is also apparent that the definition of enological ripeness has changed and planting recommendations based on a historical target fruit composition may no longer be valid.

Should degree day summation recommendations be revisited in terms of changes in consumer tastes, viticultural practices, and definitions of enological ripeness?

Are some varietals simply not able to ripen to new standards demanded in the marketplace in regions in which they have been planted? Or are other forces in play? These are important questions that need to be addressed.

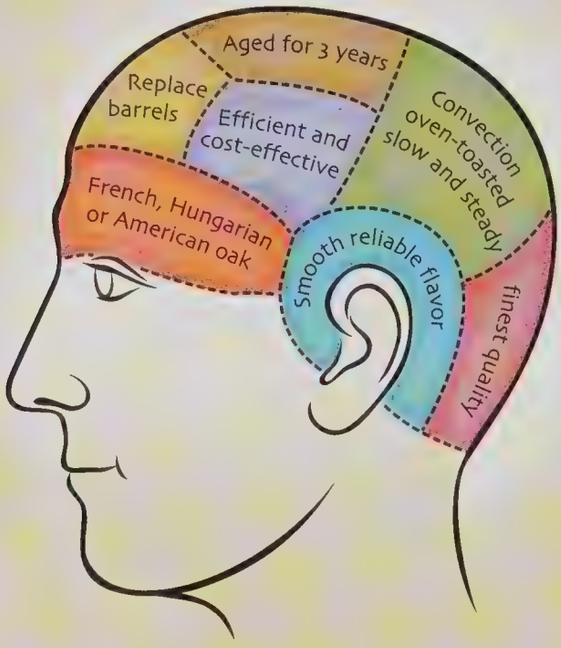
Summary

Winemakers and grapegrowers know a lot more about methoxypyrazines today than several years ago. A lot of that information can be put to work almost immediately to help grow better grapes and make better wine. The data clearly shows that MP content of a wine depends mainly on the content in the grapes it was made from, and that it is only very marginally affected by winemaking techniques. The one exception appears to be thermovinification, or heating the must or wine to approximately 60°C to 80°C for a short period, which has been shown to greatly decrease MP and could be a solution in some cases.

Winegrowers need to focus on how to manipulate methoxypyrazines to the preferred level in the vineyard. Vine balance is key to this. Vines that are undercropped produce wines with high levels of green pepper attributes, as do vines that are overly vigorous and cropped too heavily.

Because the maximum MP content is achieved prior to veraison, the period between set and veraison is when a grower can employ practices that have the most impact on the vegetal concentration of winegrapes There are significant data to show that early shoot and leaf removal are beneficial in decreasing these vegetal characters in grapes. Early season deficit irriga-

Continued on page 86



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PART I

Do corks breathe?

Origin of post-bottling sulfides

BY Alan Limmer

Redox reactions describe general principles and behavior of most wine reactions, both prior to and after bottling. Put simply, they are a series of interlinked reactions involving oxidation and reduction of various chemical species in a wine. Most wine chemistry is determined by this process.

In its simplest form, oxidation is the loss of electrons by one species, and reduction is the gain of electrons. Oxygen is not required for oxidation to occur, although it will frequently be the species that sets the "wheels in motion." For every oxidation reaction there is an accompanying reduction, as these things come as pairs.

What is really happening is that the electrons are rearranging themselves into a more favorable order. This order is determined by the redox potential of the species. This measures their propensity to exchange electrons, either by donation [oxidation] or acceptance [reduction].

These reactions happen with a predetermined precision (although often in very complex systems) as dictated by the respective redox potentials of the species involved. The most likely reactions to proceed involve the species farthest apart in redox potential, and then the next, and the next, etc. There are further complicating factors which ultimately determine the precise outcome of these reactions in some cases, such as activation energies. But for the purposes of this discussion, we do not need to consider these factors.

Cascading effects

The redox system is really a series of interlinked chain reactions, or a cascading effect. For example, dissolved oxygen, which is a powerful oxidant (as it causes species to give up electrons) in wine, in turn becomes reduced, because it is very happy to receive electrons. At this point, it should be clear that the term "reduced" has a rather precise meaning, which may have nothing specifically to do with sulfides (more on this later).

Once oxygen has entered the system, the primary redox reaction (electron exchange) will have occurred. This then permits a series of secondary and tertiary, etc., exchanges to follow from this point, because the redox potential has been altered, and so a reshuffling of the hierarchy of possible reactants occurs.

The redox potential of a wine can be measured in a similar way to pH, although it is more difficult. But the redox potential, at any point in time, reflects a wine's history in terms of redox reactions, and where the wine is at the moment.

Generally speaking, wine in tank has a lower (more reducing) redox potential than wine in barrel, indicating the more severe anaerobic conditions in tank. The redox potential is lowest at the bottom of both containers — hence the significance of lees stirring. Wine in new barrels has a higher redox potential than that in used barrels.

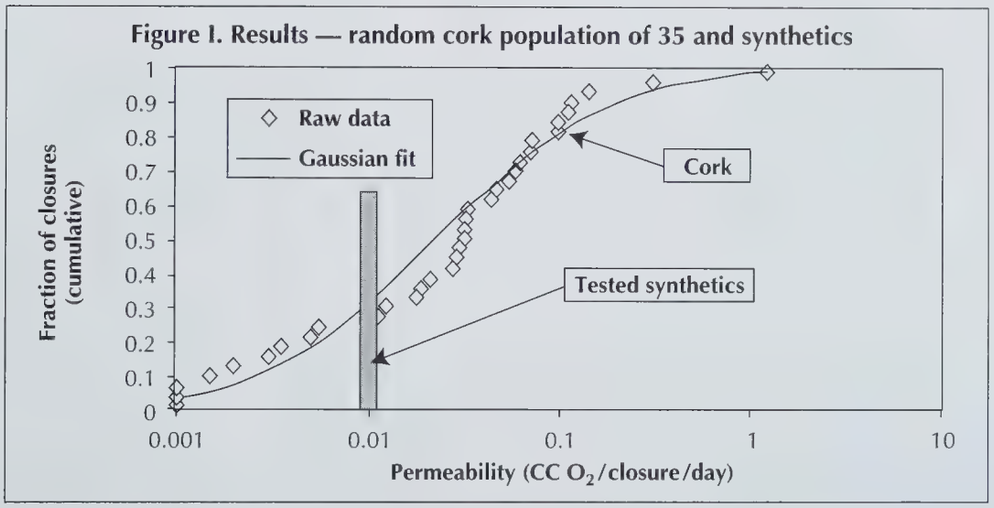
Redox/Dissolved Oxygen

Perhaps a more simple conceptual way to look at this is to exchange the words redox for dissolved oxygen. Post-fermentation, a wine is in a reduced redox (DO) state, or more loosely, reduced. This is where a common misconception arises, because this does not necessarily mean the wine is exhibiting sulfide character. The display of sulfide character, at least primarily, has more to do with the production of certain S-containing amino acids, in an effort to obtain satisfactory yeast nutrition.

Oxidation can also provide materials which may loosely be called reduced. But suffice it to say the wine will always contain sulfide precursors which will manifest themselves in various forms after fermentation, depending on the redox state.

Primarily, at least early on, a good deal of this reduced character can emanate from simple H_2S and a close relative, thiols (mercaptans). Thiols have the general form R-S-H where an

Figure 1. Results — random cork population of 35 and synthetics



H in H_2S has been substituted for an organic (Carbon) group denoted as R. R can be as simple as CH_3, the most basic organic (one C) group, or as complex as possible — leading to an array of really stinky thiols.

These compounds form the basis of skunk odor. The basic CH_3-S-H thiol is known as methanethiol and is a common constituent in wine sulfides. Simply put, thiols can be considered as substituted alcohols (CH_3-O-H = methanol) where S takes the role of oxygen. Methanethiol incidentally, is less reduced than H_2S; H_2S is oxidized to methanethiol.

Get the stink out

Given all this, we can see the error of using the "reduced" term to explain sulfide stinks, as in turn methanethiol can be oxidized to methyl disulfide (CH_3-S-S-H). This is yet another stinky reduced compound, and there is an almost endless array of these recombinations of sulfides that can form, all of which are in various states of oxidation (redox potentials) with respect to H_2S. No oxygen has entered the picture here, although it may have started the (cascading) process further up the line. But we are really referencing electron transfers when discussing reduced and oxidized.

Oxidation of thiols to disulfides is relatively easy and can occur under mild oxidation conditions — such as O_2. This, in turn, is generally accompanied by a reduction in stink. Not necessarily because any sulfides have been removed, but because the sensory thresholds for sulfides shift markedly even with very small changes in their molecular structure.

For example, if a shift from methanethiol with a sensory threshold of 2pp billion to methyl disulfide (MDS) with a sensory threshold of 50ppb occurs, immediately the character of the stink changed, and the intensity has reduced, because it takes more MDS to create a sensory impact than methanethiol.

Many, if not most, redox reactions are reversible, and the current sulfide status, as discussed above, simply reflects the redox state at that point in time. Also, as mentioned earlier, a series of cascading reactions occurs at this point, stabilizing the electron shift, which has occurred as a result of introducing oxygen at some point in the winemaking process, such as racking, filtration or bottling. Eventually, as the oxygen is adsorbed, and the reordering of electrons stabilizes, the wine will return to something near (but not quite) the original redox potential.

The response of the redox potential to an input of oxygen (at racking or bottling) is to initially incur a sharp increase in potential (towards the oxidative end). Curiously, this is shortly followed by a sharp dip in potential — below or more reductive

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than, the original potential. Eventually the potential will stabilize near the original point. During this process, a series of reducing reactions can occur again, and the MDS can become reduced to methanethiol. And the stink returns.

An important misconception regarding redox reactions is that oxidation can occur with impunity while the wine is protected with free SO_2. As discussed above, addition of oxygen sets up a cascade of redox reactions. It is a common misconception that free SO_2 scavenges oxygen and protects the wine from oxidation. This is an incorrect assumption.

While SO_2 has important oxidative protection abilities, the "antioxidant" term is something of a misnomer, as it does not prevent oxidation. It merely acts as an intermediary in the redox process of oxidation and combines with some of the oxidation products, such as aldehyde, and effectively removes them from the system. In effect, the SO_2 must wait its turn in the redox queue. SO_2 has almost negligible direct interaction with oxygen in wine.

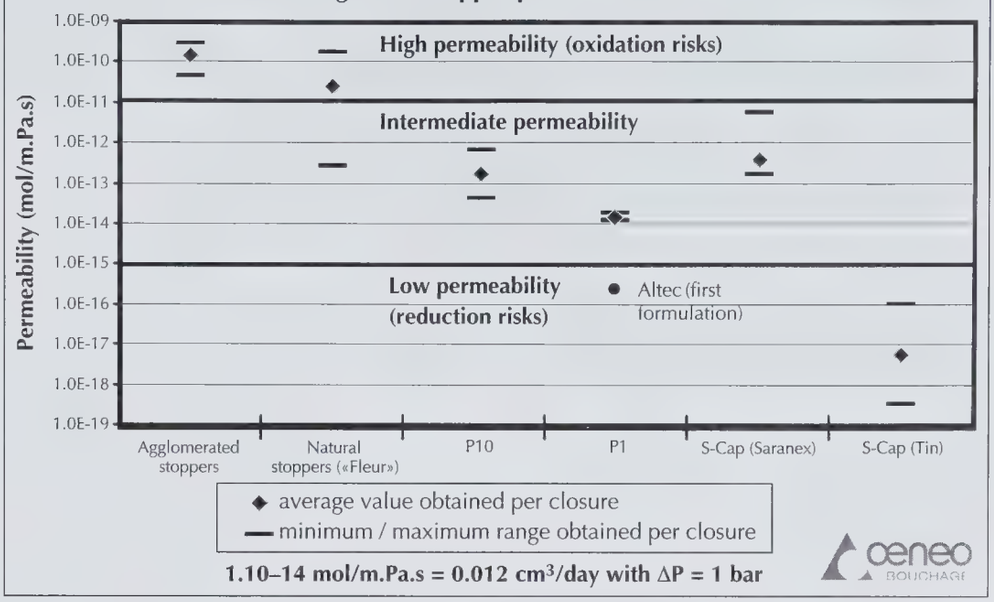
At this point, it should be obvious that redox reactions are critical to the sensory perception of a wine. General misuse of the term reduced when referring to the aromatic composition of wines has confused the situation. In other words, one can seriously oxidize a reduced (stinky) wine, but the sulfides will still be present in one form or another, as oxidized forms of the precursors, and may still stink, now or later.

Sulfide-free?

Sulfur precursors are common in wine. Trying to produce a sulfide-free wine is like looking for the pot at the end of the rainbow. There are at least three good reasons why this is so:

1) Winemakers determine these things by sensory evaluation. All these compounds have different sensory thresholds, and at best, all one can determine is that the wine, in its current redox state is below sensory detection for sulfides. The threshold levels can vary widely from dimethyl sulfide at 50ppb to dimethyl trisulfide's (DMTS) incredibly low 8pp trillion.

Figure II. Stopper permeabilities



DMTS, which is reported as smelling of drains and dead animal, has been identified as a principal component of dead animal odor. The limit and variability of human detection suggests that there is always going to be sulfide precursors in a wine no matter how "clean" we think it is. The vari-

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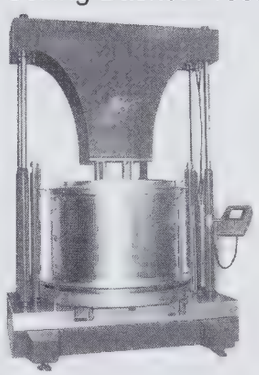

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able is going to be their behavior with varying redox potentials throughout the wine's life cycle.

2) Some (if not most) of the sulfide forms in wine are unavailable for copper fining. The only ones which can precipitate with Cu(II) ion are the simplest unsubstituted H_2S and the partially substituted thiols. All other variants do not combine with Cu(II). Depending on their compositional proportions, this mechanism is unlikely to remove every trace of all these sulfidic forms.

3) Most of these compounds are reported to have positive sensory effects at low levels (even DMTS), but become deleterious beyond those levels. Sauvignon Blanc is a good example where some complex thiols have an important positive sensory effect, but at the same time, the simple thiols (such as methanethiol) can spoil a wine. Much of the aromatic composition of a wine can be determined by S compounds.

Interesting also, the sensory attributes reported for these compounds change with their concentration. At low levels, a particular thiol may smell of peas or vegetal, and, at high levels, may smell of rotting cabbage, or worse. This may explain the wide variety of descriptors applied to individual compounds.

Getting screwed

Since introduction of the screw cap closure, a few unexpected aspects of the post-bottling behavior of wine have become evident. These require some explanation. The most evident of these aspects is the prevalence of sulfur-like odors (SLO) as noted in the Australian Wine Research Institute (AWRI) closure trials.[1] These characters are far more prevalent in, although not exclusive to, screw cap sealed wines.

Additionally, it is widely noted that wines under screw cap develop differently and generally more slowly. If winemakers adopt the view that, in all aspects, the closures are identical in performance, other than taint aspects, then it becomes difficult to ascribe a reason for SLO under screw cap.

No explanation encompasses all aspects of variations in post-bottling performance of the two closure types. One scenario, which fits all the evidence available, would involve varying redox potentials (DO) between the screw cap wines and those under cork, which exhibit a lesser incidence of SLO. However, this does require subscribing to the controversial view that corks permit ingress of some amount of oxygen.

A long held view, and particularly of late, is that corks have negligible permeability (more correctly referred to as oxygen transmission rate — OTR). This concept dates back to the early experiments of Ribereau-Gayon (1931) which demonstrated that sealing wine by cork, and the subsequent ageing process, was basically anoxic (or anaerobic) and the ageing process was one of reduction rather than oxidation. There have been more recent publications on this topic confirming this belief.[2]

The (re)introduction of the screw cap closure has been adopted on the basis that this is simply a further extension of the anaerobic ageing process and essentially no different in this respect to cork, albeit without the TCA taint, and perhaps more effective.[3,4]

Explanations for the SLOs are varied and range from corks scalping any SLO, to the fact that somehow screw caps "magnify" the winemaking faults and corks mitigate them. If the scalping theory is accepted, which is unproven, although has a reasonable basis, then winemakers are left trying to explain why some corks do show SLO.[1] That some corks may scalp, and others not, seems problematic. Also, this does not explain the ageing difference between the closures.

If winemakers accept the explanation that screw caps somehow magnify the faults, and corks do not, the imponderable remains, how? In other words,

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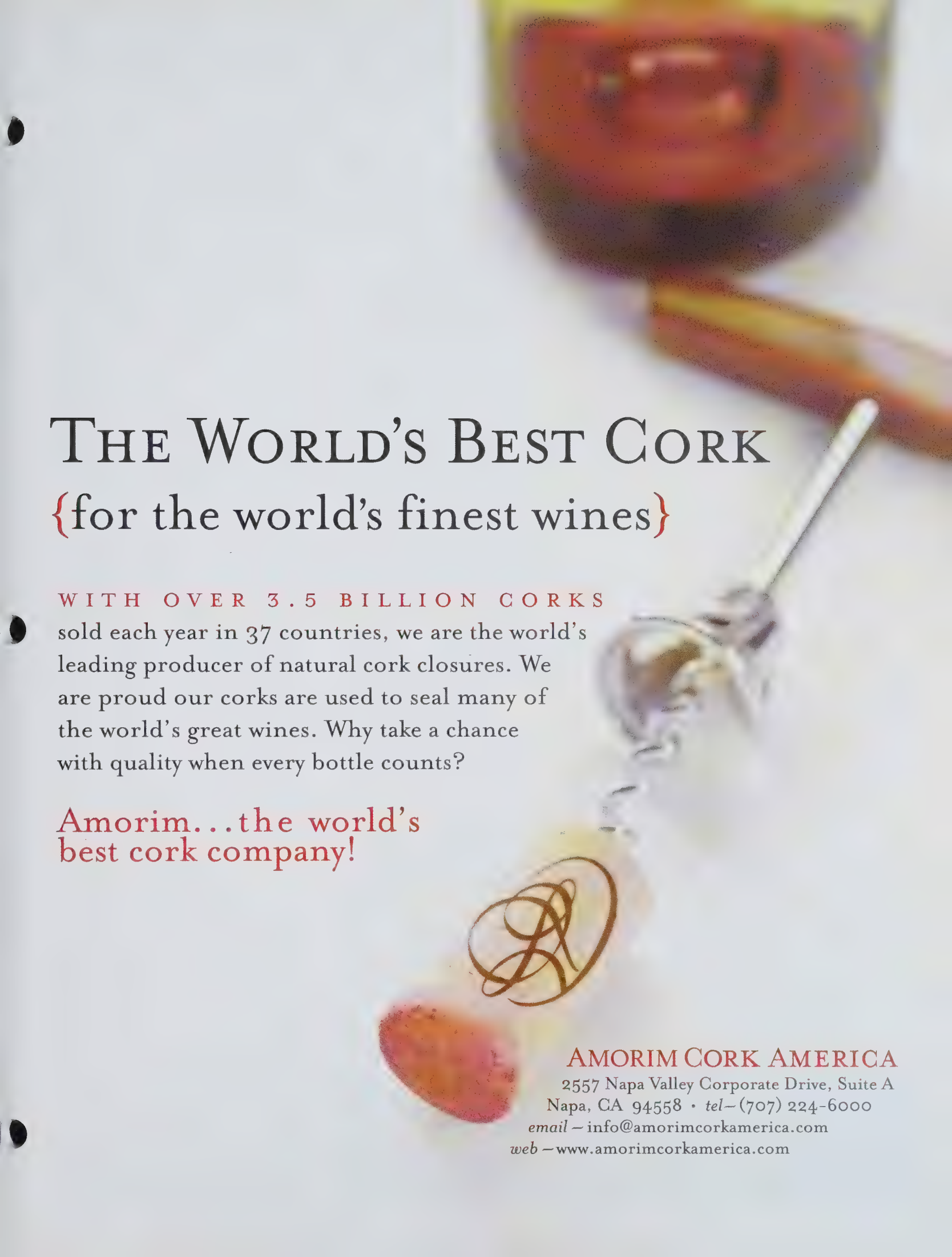

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this is no explanation for the differing behavior post-bottling under different closures.

Another explanation is that the wines were not clean before bottling and winemakers are urged to take more care. One could imagine, with the widespread noting of the occurrence of SLOs under screw cap of late, winemakers are, in general, taking more care than ever, and are certainly doing more copper(II) fining than ever before, as evidenced by the sales statistics of certain copper fining products (pers com). Yet, there are still significant incidences of SLO.

Chief judges at the 2004 Air New Zealand wine awards reported: "Too many wines were showing sulfides under screw cap. Something to watch."

Do corks breathe?

Although this may seem contrary to popular belief among some winemakers,[5] let's look at the evidence for the possibility that corks have a demonstrable OTR, that, in general, is higher than the near anoxic screw cap.

First, some bottles seem to develop faster than others. Assuming a single bottling, and common cellaring, the only variable is the closure.

Second, corks are about 85% porous (only 15% solid matter), and 85% air. That they seal as well as they do seems remarkable.

Third, it is a general observation that wine in magnums ages slower than 750 mL bottles, which in turn age slower than in 375 mL bottles. This suggests a relatively constant oxygen ingress between the two bottles producing different results in different volumes of substrate (wine).

Fourth, there are direct OTR measurements quantifying the permeability of corks. Two of these measurements are displayed in Figures I, II. Both these sets of results are largely in agreement with each other, although conducted by different institutions using different methodologies.

Solid proof

Figure I was produced from data derived from a study by Southcorp (Australia). The methodology employed is well developed and commonly used to test the porosity and permeability of other food packaging materials.

These data should not be translated as representing a quantitative assessment of oxygen ingress into wine. The following points may demonstrate the danger of this conclusion.

1) This flies in the face of the generally accepted theory of anaerobic ageing. Exchanging oxygen at volumes of upwards of 0.1 cc / day (or close on 36 mL per bottle per yr = 180mL air) hardly seems feasible.

2) If, in fact, there was a variation of 1,000-fold at these levels, individual wines would be unrecognizable. They would reflect the cork more than the wine. Yet, winemakers can generally agree on the character of a particular aged wine. If not, tasting notes would be useless, and our drinking expectations of a particular wine would be entirely random, at odds of one in a thousand of having the same bottle twice.

3) Winemakers would not be able to distinguish between the ageing differentials of wine in magnums and in 750 mL bottles.

4) Note where the synthetics lie in Figure I, the bulk of the corks sit above this band. What is known about synthetics is that their permeability is excessive for all but very short-term wines. All synthetics tested in the AWRI closure trials passed away after about three years. From this, it can be safely concluded that cork's performance under wine conditions as closures are, in fact, tightly bunched in the far left hand corner of this graph.

5) Data presented by AWRI predicted future (24 months) SO_2 levels under closures based on current six-month SO_2 levels, with a very high confidence, or predictability level (r^2 = 0.89).[6] (If r^2 had equaled unity, there would have been a perfect correlation.) This could not happen if the corks were behaving as per the permeability

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graph. In fact, this evidence alludes to exactly the opposite conclusion, by the very nature of their high degree of predictability. Further, the AWRI closure trial demonstrates a relatively consistent spread of SO_2 results at 63 months for each closure type. The tightest band of SO_2 results belongs to the Altec composite cork, with the ROTE and other closures slightly more variable.

The 36-month data are listed below.[8]

	Free SO_2	Total SO_2 (mg/L)
ROTE	17 (4)	84 (5)
Altec	17 (2)	83 (3)
One + One	12 (2)	75 (4)
Reference 2 (44mm)	9 (4)	67 (9)
Reference 3 (38mm)	8 (3)	67 (9)

The Standard Deviation values ( ) are a measure of the statistical variability of the data, and the closure performance results for each closure. The reference 2 and 3 corks show similar variation in free SO_2 results to ROTE, and about twice the variation in total SO_2, which is inconsistent with the spread of results obtained with the OTR measurements. The conclusion by some, which has permeated from these OTR data, may be an unfortunate interpretation of raw scientific data extrapolated to a complex system.[7]

The tightest of the corks are possibly what some traditionally would generally call "good" (more on this later) corks, and may be near the permeability of screw caps. This incidence of very low OTR may be responsible for the low statistical proportion of SLO seen under cork,[1] and may be a better explanation than a variable capacity for scalping SLO.

Hair perming

The fact that wines may be exposed to some oxygen ingress is not contradictory with the general notion that the ageing process occurs at very low redox potentials. Once a wine is sealed, a natural drop in redox potential is expected.[9]

Any closure, except an absolutely faulty cork, or screw cap, will have the effect of reducing a wine's exposure to air as experienced during general winemaking processes. If there will be small amounts of oxygen ingress via the cork closure as a reality, then it is possible to explain both the ageing difference between screw caps and cork and SLO incidences.

Clearly, a higher rate of oxygen ingress is going to lead to faster development of a wine, first because of the interaction of oxygen and the oxidizable substrates in wine, and consequent reduction in SO_2 level of the wine. Both of these aspects will lead to a variation in the redox potential of wine, with the higher oxygen ingress leading to an elevated (less reducing) redox potential.

An earlier section on redox behavior of sulfides explained the ready interchange between thiols and disulfides in wine, depending on the D.O. (basic chemistry). Disulfides are not able to be fined by copper(II), so not easily removed from wine. Under highly anoxic conditions, they can, and will, revert to thiols (SLO). (This is the theoretical basis of the ascorbic acid treatment in removal of disulfides in wine.)

What does this have to do with hair-perming? The answer is, everything. To perm hair, one first has to relax the natural structure of the hair — which is determined by cross-linked proteins, joined together by disulfide bonds. These bonds are broken using a reducing agent. Then hair needs to be reset to the desired shape and fix it using an oxidizing agent — or re-instate the cross-linked disulfide bonds. In this case, the reducing agent is $SO_3^=$.[10]

The reaction is concentration-dependant (first order) on both $SO_3^=$ and disulfide.[11] This provides a very good explanation why there is a strong relationship between reduced characters found in the closure trial and free SO_2.[6] Reduce the $SO_3^=$ (free SO_2) concentration by half, for a given wine, and the rate of SLO formation will be halved. But it will continue to form while there is disulfide and $SO_3^=$, just at a slower rate.

The disulfide concentration is also an unpredictable unknown in controlling the rate of SLO formation, and will vary from wine to wine. Either remove the

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SO_2 or the disulfide to stop the reaction from proceeding. Neither is particularly feasible. This reaction mechanism appears to explain all observations and experimental evidence to date on the incidence of post-bottling SLO.

With a very low OTR closure, the wine is on somewhat of a knife-edge in terms of oxidation and reduction. This is why corks have been so benevolent with respect to SLO. The low incidence of SLO seen under cork is not because some winemakers failed "Scalping 101." Rather some chose to mimic screw caps while the rest were in the more oxidative phase.

The quicker the SO_2 level drops after bottling, the less chance there is of this disulfide reversion occurring. This would also explain why some bottles of wine (under cork) seem clean, and the next one slightly closed or "dirty." Different rates of oxygen ingress.

The price for this benevolence under cork is that wine can suffer terminal oxidation at the other end faster than under screw cap (all things being equal). ■

Alan Limmer has a PhD in chemistry and 20 years experience in winemaking. He has been a director of the New Zealand Winegrowers for 12 years and is currently Chair of that organization's research program. In 2005, he was elected a Fellow of the New Zealand Institute of Chemistry. Alan is owner/winemaker of Stonecroft Wines, Hastings, North Island, New Zealand.

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Sulfur-free in Alexander Valley

Polaris 6x6 ATV pulls 100-gallon sprayer in valley floor vineyard.

BY Mark Greenspan

Sulfur has not been applied in the vineyards managed by Jim Cuneo, assistant vineyard manager, during the past three years. He does not miss it one bit. Cuneo manages the pesticide program on 317 planted acres in the Alexander Valley for Robert Young Vineyards (Geyserville, CA).

A presentation by an agricultural chemical distributor early in 2001 piqued Cuneo's interest in using JMS Stylet-Oil for powdery mildew control. Previously, micronized sulfur was applied at a rate of two pounds per acre per application.

Cuneo and Jim Young (owner), were interested in reducing or eliminating dusting sulfur to control powdery mildew disease, out of concerns by winemakers of sulfur residues in their grapes. Jim Young set a goal in 2000 to eliminate all dusting sulfur, due to concerns about drift when sulfur-dusting. Not to mention that Cuneo is somewhat sensitive to sulfur as are members of the vineyard-crew. This is a situation that many of us are in, but tend to keep quiet about it, thinking that sulfur is just a fact of life in vineyard management.

JMS Stylet-Oil is a highly refined mineral oil that controls powdery mildew disease by smothering the fungus, *Uncinula necator,* which causes the disease. The product is very simple — just the oil along with emulsifying materials. There are both organic (listed by the Organic Materials Review Institute) and non-organic formulations of JMS Stylet-Oil. For grapes, it can be applied as a 1% to 2% emulsification with water.

Dr. Doug Gubler, Extension Plant Pathologist at U.C. Davis, has compared Stylet-Oil against sulfur and other chemical fungicides and found Stylet-Oil to be highly effective when used at a 14-day interval at a 2% concentration.[1] Cuneo chose to use it at the lowest recommended concentration (1%) at a rate of 30 gallons of water spray per acre.

"Many oils are registered including OMNI oil and SAF-T-CIDE," says Gubler. "However, even though these work, they have higher phytotoxicity risks. A new product very similar to JMS Stylet-Oil is "Green" that works just as well and is also highly purified."

First trial in 2001

While mineral oil provides an opportunity to reduce or eliminate sulfur application, Robert Young Vineyards has a strict zero-tolerance policy

Robert Young Vineyards began using a two-row 200 gallon ON Target sprayer in 1995. ON-Target spray manifolds produce billions of electrically-charged drops that are attracted to the vines, resulting in excellent coverage and uniformity. Spraying two rows at 15 to 30 gallons per acre allows two to three times more acres to be sprayed in a day. For more information visit www.ontargetspray.com.

on powdery mildew, so they did not want to take the plunge into mineral oil before testing it. JMS Stylet-Oil was applied in the 2001 growing season in a 20-acre block of Chardonnay, which had a history of being a bit of a problem with regard to powdery mildew.

"Beginning at budbreak, we applied the material at 14-day intervals, adding copper to the spray tank for the first three passes in the growing season," explains Cuneo. "Copper provides additional mildew control, and helps with frost protection. After the first three applications and up through veraison, JMS Stylet-Oil was mixed with a rotation of systemic demethylation (sterol) inhibitors (DMI's) or strobulurin fungicide materials, maintaining a 14-day application interval."

They have two Adcon weather stations that monitor weather and canopy conditions on the ranch. The data is entered into the UC Davis Powdery Mildew Risk Assessment Model that determines the risk of mildew infection based on the pathogen's reproductive rate. The model allows Cuneo to decide if and for how long to stretch spray intervals. However, Cuneo feels the 14-day interval has worked well as a rule of thumb and that it facilitates manpower and equipment scheduling.

In other vineyard blocks that did not receive oil applications, the fungicides were mixed with elemental (micronized) sulfur materials at 2 pounds per acre, per their standard practice. The result: no mildew problems in the test block. Nor were there any mildew problems in the sulfur-treated blocks, indicating that the mineral oil performed as well as the sulfur did that season.

2002: Expansion to larger acreage

Their positive experience in 2001 led them to expand their no-sulfur program to all of the vineyard acreage at one property on the east side of Alexander Valley. The 67-acre ranch has

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Merlot, Chardonnay, and Syrah and includes the original 20-acre trial block. It was largely successful that year. There were some powdery mildew outbreaks in many of their vineyards that year, regardless of whether sulfur or mineral oil was applied.

"Outbreaks consisted of a cluster or berry here and there," reports Cuneo, "and an occasional vine where many clusters were infected." Bottom line: JMS Stylet-Oil performed at least as well as the sulfur did in 2002.

Spraying equipment

A lightweight spray rig was purchased to allow all-season access with less soil compaction. They purchased a Rears 100-gallon sprayer (which they generally do not fill completely to reduce the weight). They customized an over-the-row boom to adjust for 6-foot or 8-foot tractor-row spacings. Two of these sprayers are used today, each pulled by a Polaris 6x6 all-terrain vehicle (ATV).

The Rears sprayers can cover two rows in one pass. They are pulled with either a six-wheel Polaris ATV with tracks in valley floor vineyards or with a crawler tractor on hillside vineyards. These sprayers are used up until 18 inches of shoot growth.

They switch to a 200-gallon electrostatic sprayer (for the valley floor vineyards) with On-Target nozzle assemblies, which can be adjusted to spray only the extent of the vine growth at that time of year. The manifolds are adjusted to spray only the extent of foliage and a wider band as shoot growth continues. Cuneo has been very pleased with the coverage that this nozzle arrangement has provided. They began using an On-Target sprayer in 1995 and upgraded the system in 2001.

2003–2005: No more sulfur

Success in their trials led them to expand mineral oil application to the entire vineyard acreage. The previous wettable sulfur and fungicide program was substituted with JMS Stylet-Oil and fungicide applications in 2003.

Cuneo reports a complete success. Not a miracle, mind you; they still have some spot outbreaks of powdery mildew, which they deal with by dropping fruit or by washing with Kali-

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Crawler tractor pulls Rears sprayer in hillside vineyards. All photos by Jim Cuneo.

green. (In retrospect, the oil could have been used as an eradicant "wash" instead of applying Kaligreen.) But that had been their experience with sulfur also. Net gain: no sulfur drift, no respiratory irritation, and no sulfur residue on the fruit.

Benefits beyond mildew control

While the goal of using mineral oil was control of powdery mildew, the product also has beneficial insecticidal properties. Pacific mites had been a problem in many of their blocks, usually requiring one or two applications of miticide for control. In the 2001 trial block, mites were not a problem where treated with mineral oil and that block required no miticide treatment, unlike some of the sulfur-treated blocks, some of which did require miticide applications.

In the years preceding the trial, Agrimek and/or Nexter were needed as applied twice to control mites, 100 acres being treated in 2001 and 30 acres

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in 2002. In subsequent years, when mineral oil was used in all of their vineyards, it was found that mite populations were much less of a concern compared to previous experiences.

There were some mite hotspots in 2003 and in 2005 (but none in 2004) which required one or two miticide applications. Twelve acres required miticide treatment in 2003 and 50 acres in 2005. But the hotspots were well-defined and the mite infestations less severe than in previous experiences or in comparison to what their neighbors encountered during those same episodes.

Although it appeared that JMS Stylet-Oil seemed to have some suppressive effect on mite populations, they wanted to know if it could be relied upon for that purpose. They tested this by applying mineral oil at a 2% rate on a few mite-infested rows in 2005. To their dismay, it did not suppress the population sufficiently to justify use as a miticide. However, they remain encouraged that it helped to reduce their overall need for miticides in the vineyards.

Another benefit found was that of leafhopper suppression. The mineral oil suppressed populations of leafhoppers, minimizing the need for a pre-harvest application of Provado.

Downside to mineral oil

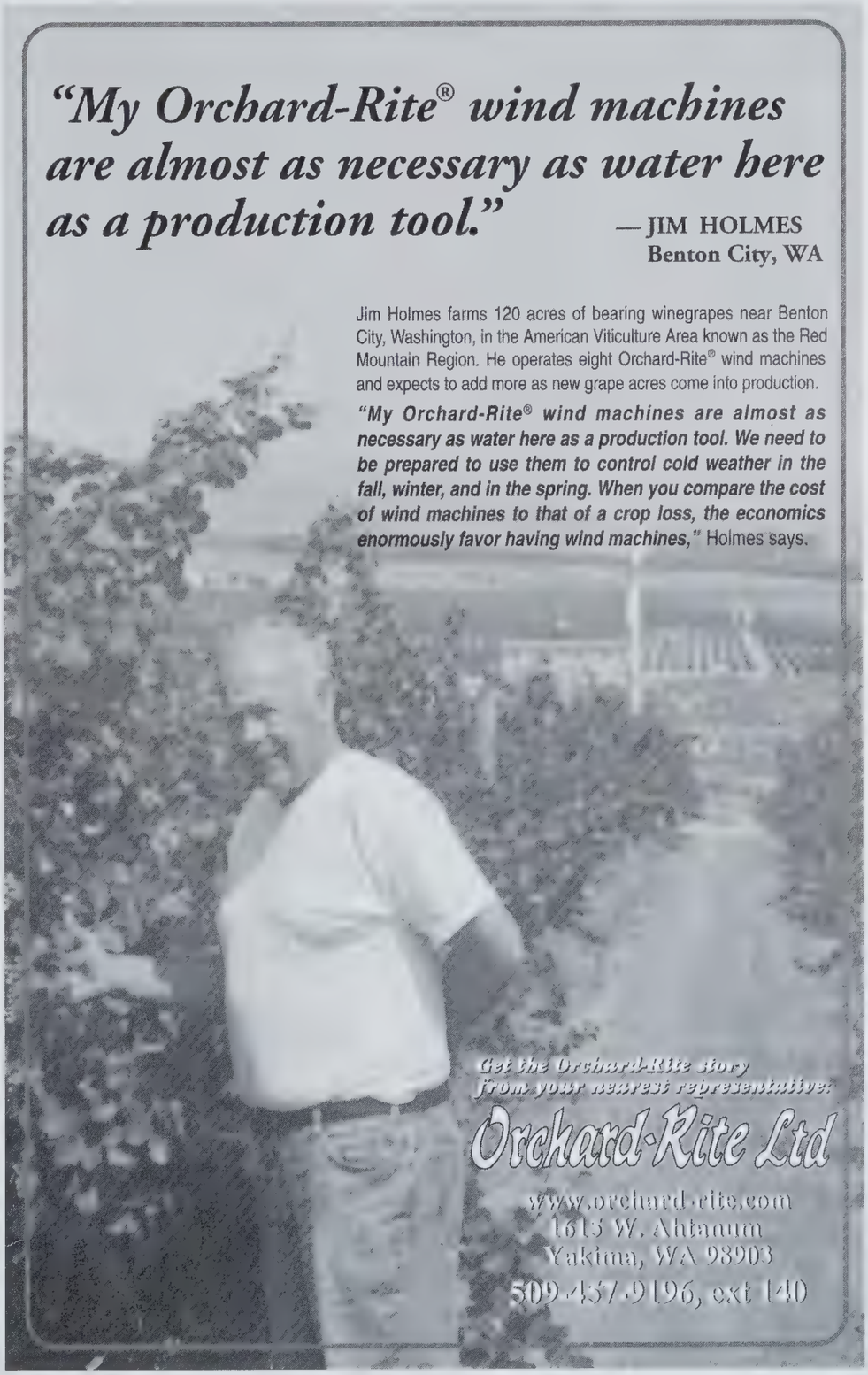
There are caveats to mineral oil application — sulfur cannot be applied within 14 days of JMS Stylet-Oil application or vice versa, or any potential hot weather that could toast the leaves to a crispy crunch. That is clearly stated on the product's label.

With or without sulfur, spraying in hot weather can cause over-heating and burn of oil-treated foliage. Cuneo's crew begins spraying at midnight and continues until morning in order to apply the material under the coolest conditions. Spraying is halted at 11 am, or earlier if the temperature reaches 80°F as a precaution.

Cuneo reports using the lowest recommended concentration (1%) in their spray, and he thinks that the lower concentration helps to avoid heat-related foliar damage. He has seen no foliar damage in their oil-treated vineyards with temperatures into the 90's when spraying is has been halted before 80°F is reached.

Another minor downside to mineral oil was that spray volume by electrostatic sprayer increased 50%, from 20 gallons per acre to 30 gallons per acre. This would necessitate more spray-tank refills, but did not seem to be a serious issue to Cuneo. Also, material cost is somewhat higher with mineral oil than sulfur. Cuneo's material costs increased about $1.50/acre per application when changing from micronized sulfur to JMS Stylet-Oil. Growers using a higher rate of sulfur than two lbs per acre will see less of an increase in material cost.

Cuneo mentions another downside to using mineral oil — it tends to coat some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of the waxy bloom on berries, giving it the appearance of having water spots. Neither he nor the winemaker are concerned about this cosmetic effect. In his lab, Dr. Gubler found that the presence of residual oil had no negative effects on yeast growth during fermentation.[1]

It appears that, for Jim Cuneo and Robert Young Vineyards, the advantages of using JMS Stylet-Oil for mildew control far outweigh the negatives. ■

NOTE: While Robert Young Vineyards has shared their positive experience with using JMS Stylet-Oil for powdery mildew control, there is no expressed or implied recommendation for its use. Please conduct your own investigation and experimentation before embarking on a similar program.

Dr. Mark Greenspan is the founder of Advanced Viticulture LLC (Santa Rosa, CA) [www.advancedvit.com] providing consulting services to wineries, winemakers and winegrowers interested in producing premium wine products. He has 17 years of scientific research and viticultural experience, and specializes in irrigation and nutrition management, yield and canopy management, fruit maturation and vineyard technology. He may be contacted at mark@advancedvit.com or tel: 707/568-5256.

For more information on disease control and fermentation, and sulfur residue and wine quality, readers are invited to pursue the following research published by Dr. Doug Gubler and cooperating researchers:

1. 1997 Dell, K.J., W.D. Gubler, R. Krueger, M. Sanger, and L.J. Bettiga. "The efficacy of JMS tylet oil on grape powdery mildew and Botrytis bunch rot and effects on fermentation." *Am. J. Enol. & Vitic.* 49(1): 11–16.

2. 1993 Thomas, C.S., R.B. Boulton, M.W. Silacci, and W.D. Gubler. "The effect of elemental sulfur, yeast strain, and fermentation medium on hydrogen sulfide production during fermentation." *Am. J. Enol. & Vitic.* 44(2): 211–216.

No sulfur application at Fanucchi Vineyards

Much like Robert Young Vineyards, neighboring winegrower David Fanucchi has not used sulfur on his vineyards for three years. The Fanucchi family has been farming their Alexander Valley property since 1948 and currently farms 57 acres of Syrah, Merlot, and Cabernet Sauvignon.

Like Cuneo, he wanted to eliminate sulfur drift, mite flare-ups, and irritation to his vineyard crew and made the switch to JMS Stylet-Oil during the 2002 season. Fanucchi is aggressive with the oil, applying it to some problematic blocks even before budbreak if

Continued on page 59

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Fertilizer efficiency for winegrape vineyards

BY Stan Grant
Progressive Viticulture

In the winegrape business, competition is more intense than ever before. Grape growers, through their winery customers, are feeling the pressure of imported wine. Just as real, but less often considered, is the competition among U.S. growers producing grapes for wines at the same price-point.

The only reasonable response to competition, and the only way for a vineyard enterprise to prosper, is to farm smarter. This includes capturing the greatest possible return on operating expenditures, such as fertilizers. This article addresses fertilizer efficiency for winegrape vineyards.

Fertilizer efficiency

Fertilizer efficiency represents fertilizer performance per unit cost, not fertilizer cost alone or nutrient content. Fruit yield is the most common measure of performance, but balanced growth and fruit quality are increasingly important to winegrape growers. For researchers, fertilizer efficiency can be the amount of fertilizer nutrient that is taken up by the plant.[24]

Perfect fertilizer efficiency involves the exact amount of mineral nutrient, in the right form, in the correct place, at the proper time to be entirely taken up and used by grapevines. In reality, perfect fertilizer efficiency is not possible due to technological, environmental, and grapevine constraints.

Technological factors that influence fertilizer efficiency include application rate and timing, placement, and formulation. Due to several technological advances that have greatly improved fertilization efficiency, fertilizer technology is often the least limiting of the factors affecting fertilizer efficiency in vineyards.

Table I. Liquid fertilizers commonly used for winegrape vineyard fertigation[1].

Name	Analysis (2)	Effect on Soil pH
Urea Ammonium Nitrate or UAN-32	32-0-0	Acidifying
Calcium Nitrate or CN-9	9-0-0-11(Ca)	Basic
Calcium Ammonium Nitrate or CAN-17	17-0-0-8.8 (Ca)	Mildly acidifying
Ammonium Polyphosphate	10-34-0	Acidifying
Phosphoric Acid	0-54-0	Acidifying
Potassium Sulfate or ESP	1-0-8-2.5(S)	Neutral
Potassium Chloride	0-0-10-8(Cl)	Neutral

[1] Sources: Burt (1998), Christensen (1995), Farm Chemical Handbook (2001), Mid Valley Agricultural Services (2002), Western Fertilizer Handbook (1998).

Fertilizer efficiency is optimized when application timing or availability in the soil coincides with periods of high nutrient demand and uptake. For example, potassium fertilizer efficiency is often greater in early to mid-summer when soils have warmed, roots are highly active, and berries are rapidly growing than earlier in the growing season. For most nutrients, less value is captured from fertilizer applied during the winter when vines are dormant. (For more information regarding fertilizer application timing, refer to *PWV* May/June2002).[6]

In general, several low-rate applications are more efficient than infrequent high-rate applications. Exceptions include phosphorus- and potassium-deficient vineyards, which usually require large applications to satisfy both the nutrient absorption capacity of the soil and grapevine needs. In all circumstances, application rates that greatly exceed vine needs and uptake capabilities are inefficient.

Placing fertilizer in or on the soil near active roots is much more efficient than placing it where there are no roots. Placement of dry fertilizer to correct phosphorus and potassium deficiency is particularly critical. In these vineyards, fertilizer is most effective when placed in a concentrated band on or below the soil surface adjacent to the vine row.[4,6,21] Such placement saturates the soil's absorption capacity and leaves the remaining fertilizer nutrients available for vine use.

Fertilizer formulation is critical, because it determines solubility, the requirement for conversion by microbes within the soil, the likelihood of fixation within the soil, relative ease of uptake by vine roots, the potential for loss from the soil, and the potential for undesirable side effects on soil chemistry.

Improper use and poor maintenance of application equipment degrade the value of fertilizer technology and erode fertilizer efficiency. Proper use of ground application equipment includes correct calibration. Spray applications are optimized when the equipment ground speed is correct and consistent as possible, droplets are of the appropriate size, and a minimum amount of spray misses the target.

When the target is the grapevine canopy, optimization includes complete coverage with minimum run-off. Proper applications into irrigation water involve full charging of irrigation systems before fertilizer injection, sufficient runtime for uniform fertilizer distribution, and a flushing period after injection of sufficient duration to completely flush the system.

Several plant factors affect fertilizer efficiency. One such factor is grapevine nutrient demand. Potential fertilizer efficiency is highest during or shortly before periods of high nutrient demand. For example, pre-bloom and bloom foliar zinc applications provide greater fruit set benefit and economic return than applications made at other times.[4]

Root system condition has a significant impact on fertilizer efficiency. Younger roots (and leaves) absorb fertilizer nutrients more readily than older tissues.[14] Limited root system distribution and extensiveness will limit access to soil-applied fertilizers, thereby decreasing efficiency.

For example, vines with root systems limited by soil-borne pests (*Phylloxera* and nematodes) have greater difficulty in taking up fertilizer nutrients. Under such circumstances, a comprehensive soil management program involving organic soil amendments, fertilizers, and frequent irrigation can enhance root growth and extensiveness, thereby improving potential fertilizer efficiency.

Rootstocks influence mineral uptake and movement within a grapevine, as well as root system distribution and extensiveness. For example, Freedom rootstock is highly effective in acquiring phosphorus.[7]

Similarly, leaf characteristics, such as amount of pubescence vary with winegrape variety and, as a result, so do capabilities to take up mineral nutrients from foliar-applied fertilizers. Clearly, some scion-rootstock combinations are inherently more efficient fertilizer users than others.

In soils, several possible fates await a recently applied fertilizer nutrient. The best possible outcome, and the most efficient, is uptake by a grapevine root. However, direct uptake is limited for some fertilizer formulations, such as urea-nitrogen. These molecules are normally converted to a form more readily taken up by vine roots (mostly nitrate).[21] Alternatively, a fertilizer nutrient may be precipitated as an insoluble compound, trapped between clay layers, adsorbed on the exterior of a soil particle, or otherwise fixed by the soil and made unavailable to vines.

Grapevines have sources of competition for mineral nutrients other than the soil reactions mentioned above. Mineral nutrients already present in the soil solution may compete with a particular fertilizer nutrient for uptake by grapevines (such as magnesium competing with potassium).[21] Soil microbes also compete for nutrients, and their numbers and nutrient-consumption temporarily swell after a nitrogen-fertilizer application.[21] Weeds are very effective competitors that can greatly diminish the value of a fertilizer application.

Adverse soil conditions that impair root function and health will limit the uptake and efficiency of applied fertilizer nutrients. These include excessive moisture, compaction, low temperatures, and high salinity.

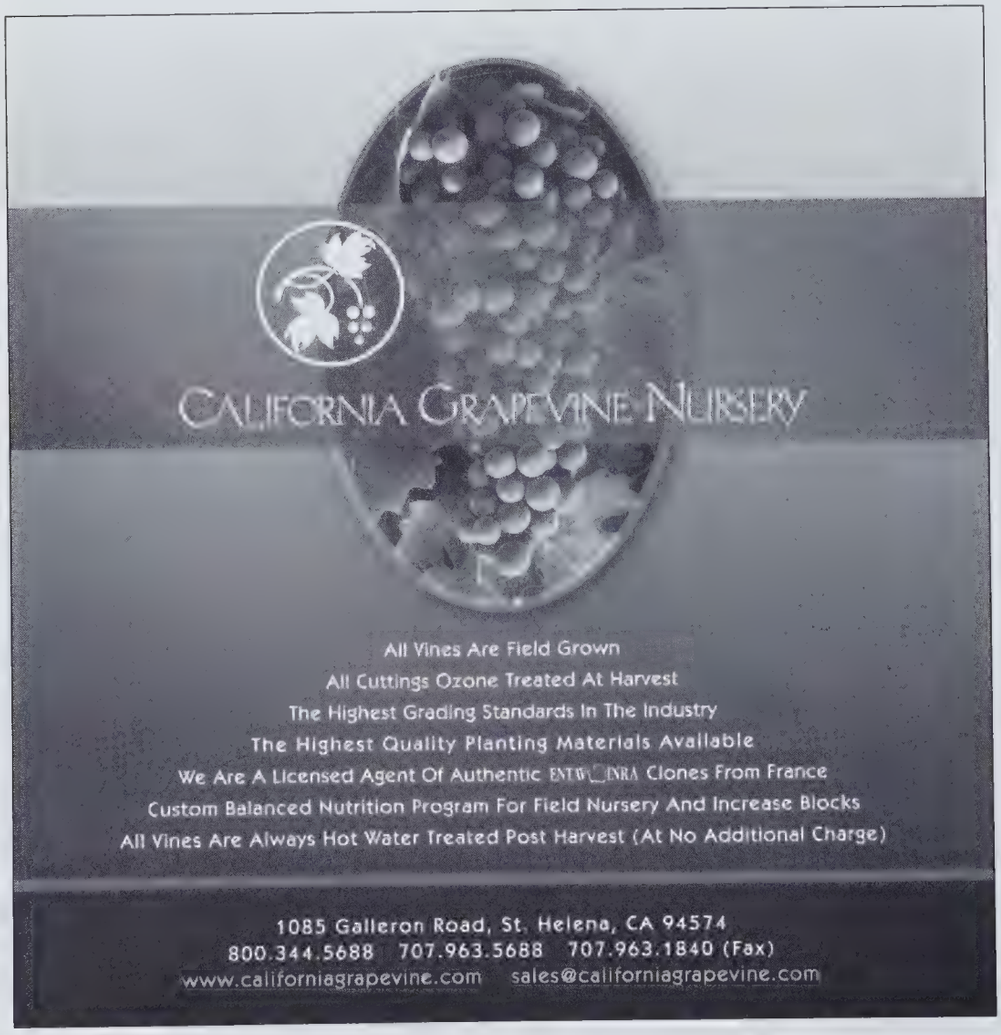
Vine leaves absorb foliar-applied nutrients most effectively when fertilizers dry slowly and fertilizer efficiency suffers during hot, dry, or rainy weather. Sunlight also promotes foliar nutrient uptake.[14]

Losses to the environment are the last major factor limiting fertilizer efficiency. Some fertilizer formulations (such as ammonia) readily volatilize and may be lost to the atmosphere without careful management.[21] Other highly soluble nutrients (such as nitrate) are prone to leaching from the root zone.[2,21] Another avenue to loss is surface run-off, which carries nutrients attached to soil particles.

Fertilizer industry's technological advances

Soil amendments (organic wastes and mined mineral materials) and leguminous cover crop residues are the traditional inputs for managing vineyard mineral nutrient supplies. These materials can serve as effective fertilizers, but have the disadvantages of bulk, low nutrient content, and slow and somewhat unpredictable nutrient release that frequently is not in synchrony with vine requirements.[17]

For this reason, they often fail to provide sufficient nutrients to avoid deficiencies in grapevines, especially in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soils with very low quantities of available nutrients, soils that absorb large quantities of applied nutrients, and for vineyards with a very large nutrient need (such as high-density plantings and vineyards with large crops). Even under the best circumstances, the fertilizer efficiency of soil amendments and cover crop residues is usually low in winegrape vineyards.

While organic amendments may not be highly efficient fertilizers, repeated applications can increase soil organic matter. Soil organic matter serves several functions critical to sustained productivity in vineyards, including contributing to a soil's cation exchange capacity (CEC) or ability to retain positively-charged nutrients like potassium, calcium, and magnesium. As supplies of these nutrients in the soil solution are depleted, nutrients held by organic matter reenter the soil solution and buffer the nutrient supply available to vines. By this action, organic matter increases fertilizer nutrient residence time in the soil, the opportunity for uptake by vines, and the benefit of the fertilizer.

A few types of refined and manufactured fertilizers have been available since the late 19th century, but they did not become widely used until after World War II.[1,17,21] For the most part, these fertilizer products are inorganic salts (such as ammonium phosphate). Compared to soil amendments, they are concentrated and release nutrients rapidly and predictably. These characteristics allow them to saturate a soil's absorption capacity and meet very large nutrient needs. In spite of these advantages, refined and manufactured fertilizers are still subject to inefficiencies. These include application timing and placement limited by tractor-pulled equipment, and for some fertilizers, slow solubility in soil moisture.

Research reports of foliar fertilization of grapevines first appeared in the 1950's.[25] The technique was quickly adopted for correcting micronutrient deficiencies.[4] The foliar technique supplies nutrients more rapidly than techniques involving the roots, but benefits are shorter lived.[14] The efficiency of foliar fertilizer application is limited by the low capacity of foliar organs to absorb mineral nutrients. In general, there is greater flexibility in in-season fertilizer application timings with foliar compared to other ground based application methods.

Chelation

Chelation is an innovation that increases availability of certain mineral nutrients and, thereby, potential fertilizer efficiency. A chelate is a compound involving a mineral nutrient and a surrounding, protective organic molecular structure.[2,21] Chelates are expensive to

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Table II. Recently developed fertilizer products commonly available in California for winegrape vineyard fertigation.

Product	Fertilizer Formulation	Analysis	Vineyard Uses	Manufacturer
K-MEND	Potassium thiosulfate	0-0-25-17(S)	Rapid K uptake, fertilizer mixes, alkaline soils	Best Sulfur Products
K-Thio	Potassium thiosulfate	0-0-25-17(S)	Rapid K uptake, fertilizer mixes, alkaline soils	Na-Churs Alpine
KTS	Potassium thiosulfate	0-0-25-17(S)	Rapid K uptake, fertilizer mixes, alkaline soils	Tessenderlo Kerley
Thiocal	Calcium thiosulfate	0-0-0-10(S)-6(Ca)	Rapid Ca uptake, alkaline soils	Best Sulfur Products
CaTs	Calcium thiosulfate	0-0-0-10(S)-6(Ca)	Rapid Ca uptake, alkaline soils	Tessenderlo Kerley
MagThio	Magnesium thiosulfate	0-0-0-10(S)-4(Mg)	Rapid Mg uptake, fertilizer mixes, alkaline soils	Tessenderlo Kerley
pHighter-K	Potassium carbonate	0-0-28-3(org. acids)	K for acid soils & high sulfur soils	Actagro
0-0-30	Potassium carbonate	0-0-30	K for acid soils & high sulfur soils	Na-Churs Alpine
Organocal	Calcium carbonate & organic acids	1.2-0-0-20(Ca)-2(org. acids)	Ca for acid soils & high sulfur soils	Actagro
Mainstay Calcium	Calcium carbonate (encapsulated)	0-0-0-20 (Ca)	Ca for acid soils & high sulfur soils	Redox Chemical
Mainstay Magnesium	Magnesium carbonate & magnesium hydroxide	0-0-0-20 (Mg)	Mg for acid soils & high sulfur soils	Redox Chemical
Structure	Nitrogen & phosphorus organic acid complexes	7-21-1-7(org. acids)	Fertility programs emphasizing N & P	Actagro
Cache	Nitrogen, phosphorus, & potassium organic acid complexes	4-6-10-3(org. acids)	Fertigation programs emphasizing N, P, & K	Acatagro
Monarch	Nitrogen,phosphorus, & potassium organic acid complexes	2-20-15-3(org. acids)	Foliar fertilization	Actagro

produce and, for this reason, are usually cost-effective only for mineral nutrients required in small quantities.[2] Chelates of zinc, manganese, iron, and copper have become standard products for foliar application in many vineyards. Chelate efficiency is reduced in soils by salinity and acidity, and some chelates are better adapted to certain soil conditions than others (for example, diethyleneaminepentaacetic acid [DPTA] works better in alkaline soils than ethylenediaminetetraacetic acid [EDTA]).[2]

Amino acid chelation is a recent technology that has further enhanced nutrient-uptake and foliar-fertilizer efficiency.[10,11,12] Amino acids are components of proteins found in all organisms. In fertilizers, amino acid chelates possess a pseudo-natural structure that is small, rounded, highly-soluble, neutral in charge, and therefore, readily taken up and used by foliar grapevine tissues (leaves, stems, and clusters).[23] Amino acids contain a small amount of nitrogen that has fertilizer value. Some amino acid chelate fertilizers are approved by the Organic Materials Review Institute (OMRI) for organic vineyards.

Fertigation

Perhaps the most important innovation leading to improved fertilizer efficiency is not a fertilizer technology, but rather the irrigation technology known as micro- or drip irrigation. Using a drip-irrigation system, a winegrape grower can apply fertilizer any time, and place it where grapevine roots are most numerous and active.[2,17,21] In other words, drip irrigation overcomes the timing and placement limitations of tractor-pulled application equipment. Actually, it eliminates the need for tractors, application equipment, and tractor drivers, allowing most of the fertil-

izer application costs to be absorbed as irrigation costs.

Fertigation is the practice of applying fertilizers with irrigation water. In addition to greater flexibility in application timing and optimal placement, fertigation increases the rate of nutrient uptake and predictability of vine response to fertilization compared to broadcast and band applications.[2,18,20] Consequently, it is normally the most efficient fertilizer application method.

Fertigation is evolving along with grower's understanding of soils and grapevines. The total seasonal nutrient need of a vineyard can be estimated based on yield, vigor, and soil conditions. This is used to create a schedule of nutrient applications to meet specific needs of particular developmental stages (pre-bloom, post-bloom, ripening, and post-harvest). These balanced fertigation strategies optimize nutrient availability and avoid nutrient imbalances (deficiencies and excess), greatly increasing fertilizer efficiency.[6]

Fertigation is especially valuable mid-season, after moisture stored from winter rains has been depleted and the active root zone is maintained under the vine row where water is being periodically applied. In this limited volume of soil, chemical changes are much more rapid than in the surrounding soil, including nutrient depletion by vine roots.[6,16] Just as rapidly, the nutrient supply can be efficiently restored through careful fertigation. The key operative is careful, because careless fertigation is not efficient and can produce undesirable side effects, including soil acidification, salinization, loss of soil structure, greatly diminished microbial activity, and pollution of the environment.

Fertilizers suitable for fertigation fall into two categories: highly soluble solid (solution grade) fertilizers and clear liquid fertilizers.[2] Many conventional fertilizers, such as potassium sulfate, have been adapted to fertigation through refining and reformulation (Table I). Micro-nutrients, such as zinc chelates, are also effectively applied by fertigation.[21]

Fertilizers for fertigation

In recent years several innovative, highly soluble fertilizers have been developed expressly for fertigation. These include the thiosulfates, carbonates, hydroxides, and organic acid complexes (Table II). Some of these materials have characteristics that lend themselves to specific soil conditions, while others are suitable for a wide range of soils. Most of them have been available for a relatively short period – so short that little research information about them is available. Some of them remain to be fully tested under field conditions.

Potassium and calcium thiosulfate are more soluble than sulfate based fertilizers. They also appear more efficient than sulfate and chloride-based fertilizers.[9,5]

Potassium thiosulfate, compared to other potassium fertilizers, has the dual advantages of high potassium content (about 2.5 lb K per gal) and low soil salinization potential. It also contains more sulfur and results in greater sulfur uptake than liquid potassium sulfate.[8]

In 2005, magnesium thiosulfate became available as a liquid alternative to magnesium sulfate. Like other thiosulfates, it can be mixed with other fertilizers to make nutrient blends suitable for balanced soil fertility programs.[2] All thiosulfate fertilizers have one characteristic that is disadvantageous under some circumstances — they tend to acidify soils. Potassium thiosulfate has the greatest capacity for soil acidification among the three fertilizers discussed.

Some soils are not amenable to thiosulfate fertilizers. For example, certain soils have an overabundance of sulfur, but require potassium, calcium, and/or magnesium. Also, most strongly acid soils require potassium, calcium,

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and magnesium, but responsible management of these soils precludes the use of acidifying fertilizers, no matter how slight their effect. The soil under the emitters in most vineyards becomes acidic over time due to the leaching of minerals and application of acidifying fertilizers, including N-P-K blends used in balanced soil fertility programs.

Fortunately, a few fertilizers neutralize soil acidity. Perhaps the best known of the alkalinizing fertilizers is calcium nitrate, which is a highly efficient source of calcium, but calcium nitrate applications are limited by the adverse side-effects of excess nitrogen on vine vigor and fruit quality. Liquid formulations of calcium carbonate are an effective supplemental source of calcium under these conditions. Acid soils are usually low in potassium and magnesium and liquid formulations of potassium and magnesium-carbonate and hydroxide are adapted to them.[19,21]

It is important to note that the fertilizers described above will have a limited effect on soil pH because they are applied at low rates. They are not substitutes for agricultural lime or dolomite to raise the pH of an acid soil. They must be injected slowly into high calcium and magnesium irrigation water to avoid clogging of drip emitters.

Humic substances are a complex group of large, stable organic molecules found in very old deposits.[13,16] Mineral nutrients complexed (lightly-bonded) with humic substances can be highly effective fertilizers.[22] They act similarly to chelates by improving availability of the mineral nutrient, but unlike chelates, plants can absorb them in their entirety.[3] In this way, they act as a nutrient delivery system. Also unlike chelates, they are comparatively inexpensive to produce and are cost-effective for soil, as well as foliar application of both macro-nutrients and micro-nutrients.

In addition, organic acids increase the solubility of some mineral nutrients under acid and alkaline conditions.[16] There are several formulations of organic acid-complexed fertilizers with various mineral nutrients. Some organic-complexed fertilizers are OMRI-approved.

Conclusion

There is ample opportunity to optimize the efficiency of fertilizer use in your vineyard, regardless of your production goals. Keep in mind that efficiency is measured by performance per unit cost, not fertilizer cost alone or nutrient content. Use the combination of technologies that renders the greatest return on your fertilizer investment within the constraints of your scion-rootstock and vineyard environment. ■

The author is grateful to Barbara Grant, Rob Mikkelsen, Tom Gereke, Tom Fairweather, Mid Valley Agricultural Services and the staff of ***PWV*** *for their assistance in the preparation of this article.*

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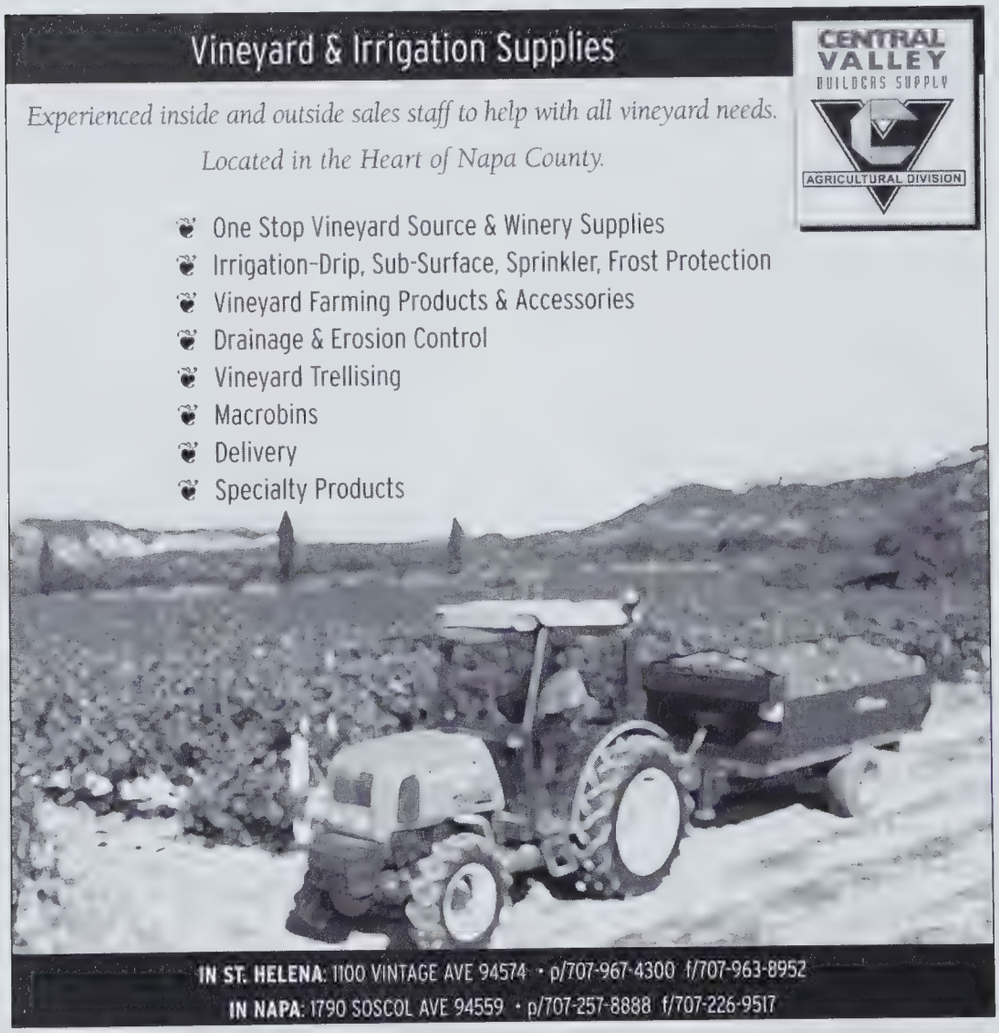
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RESEARCH IN GRAND RIVER VALLEY (OHIO) 1994-2005

Wind Machines help manage winter injury

Photo provided by Orchard-Rite®

BY Gene Sigel, Vineyard Manager
Debonné Vineyards, Madison, OH

Wind machines are widely used in California for frost protection and in Washington for winter injury protection. On calm and clear nights, and even with light winds, the air separates into layers, with colder layers at the vineyard floor and warmer layers 40 to 60 feet above ground. Wind machines raise temperatures in the vineyard by circulating the warmer with the colder air layers.

This approach to winter-injury management was generally dismissed in the mid-1990s by the eastern U.S. viticulture research community with the presumption that "the large inversions found in the western U.S. do not occur along the Great Lakes and Finger Lakes," especially in winter.

As a result, today, despite repeated recent winter-injury episodes, not one grapegrower in the Finger Lakes uses wind machines. However, in the vineyards ringing Lake Erie, many new wind machines were erected in 2005. Is there evidence that these machines can combat winter injury? Will they work on any site?

Vineyard in Grand River Valley

The Grand River Valley American Viticultural Area is a four-mile-wide band centered on the Grand River Canyon, 10 to 14 miles south of Lake Erie. At Debonné Vineyards, Ohio's largest estate winery, gently rolling hills cascade north both to the river canyon and also to the lake, with vineyards set on high ridges composed of wet, clay soils.

For generations, fruit farms in this region were broadly classified by farmers either as "frost-free" or "frost prone." Wind machines have been used successfully in the region since the 1960s for frost control on the most frost-prone Concord grapevine sites. The newest vineyards of vinifera and hybrids at Debonné are planted on both types of sites.

Two significant winter kills occurred in this area during the winters of 1993/1994 and 1996/1997. At about the same time, Debonné began a vineyard expansion program to double the winery's 55 acres to 110.

Vulnerability of the vines to winter freeze was of prime concern. Winter temperature research was begun to see if the patterns of winter-kill seen in 1994 and 1997 could be explained based on cross-sectional temperature differences between sites on cold nights, and temperatures were systematically recorded and examined to see whether inversion layers existed. The hope was to identify and plant on frost-free sites in order to avoid winter injury in the future.

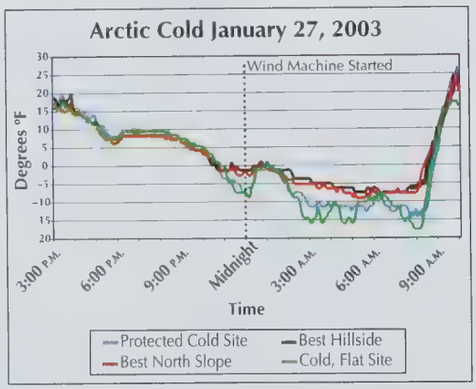


Figure 1. The First Arctic Blast Since 1993–1994 — At midnight on January 27, 2003 the Grand River Valley saw the first sub-zero temperatures in five years. One Orchard-Rite® wind machine was started at midnight in the protected, cold site. Temperatures are recorded at four sites every six minutes.

1999–2003 results

Beginning in the fall of 1998, winter temperatures were monitored every six minutes at five vineyard sites. Some were prime frost-free sites; others were notorious frost pockets. The five sites are representative of the range of vineyard sites we manage, including cold and unprotected sites; cold sites that are protected by a wind machine; steep north-facing slopes; hilltops; and flat, colder sites.

Across the five sites, winter temperature inversions were determined to match or exceed those in the spring; good sites to avoid frost were also warmer in the winter, apparently. Spring "inversions" — temperature differentials between bad and good sites — ran 5° to 10°F. Winter

differentials were even greater, reflecting a 10° to 15° premium on the best sites.

We knew that a wind machine might capture these inversions on poor sites in the spring, but we were concerned that winter air might simply be too cold to mix effectively and produce much of a temperature change. However, from 1997 to 2002, there was almost no sub-zero weather to test these theories. Finally, on the night of January 27, 2003, that all changed. Temperatures plunged to –8° and even as low as –27°F across Debonné vinifera vineyards. One Orchard-Rite® wind machine was started around midnight and run until dawn.

Figure I shows the best sites with no machines settled at –8°F. The one protected site on 20 acres with one machine settled at –10° to –12°F. On the unprotected, flat site, repeated shots of –15° to –18° were recorded, although this site is only 600 feet away from the "best hillside."

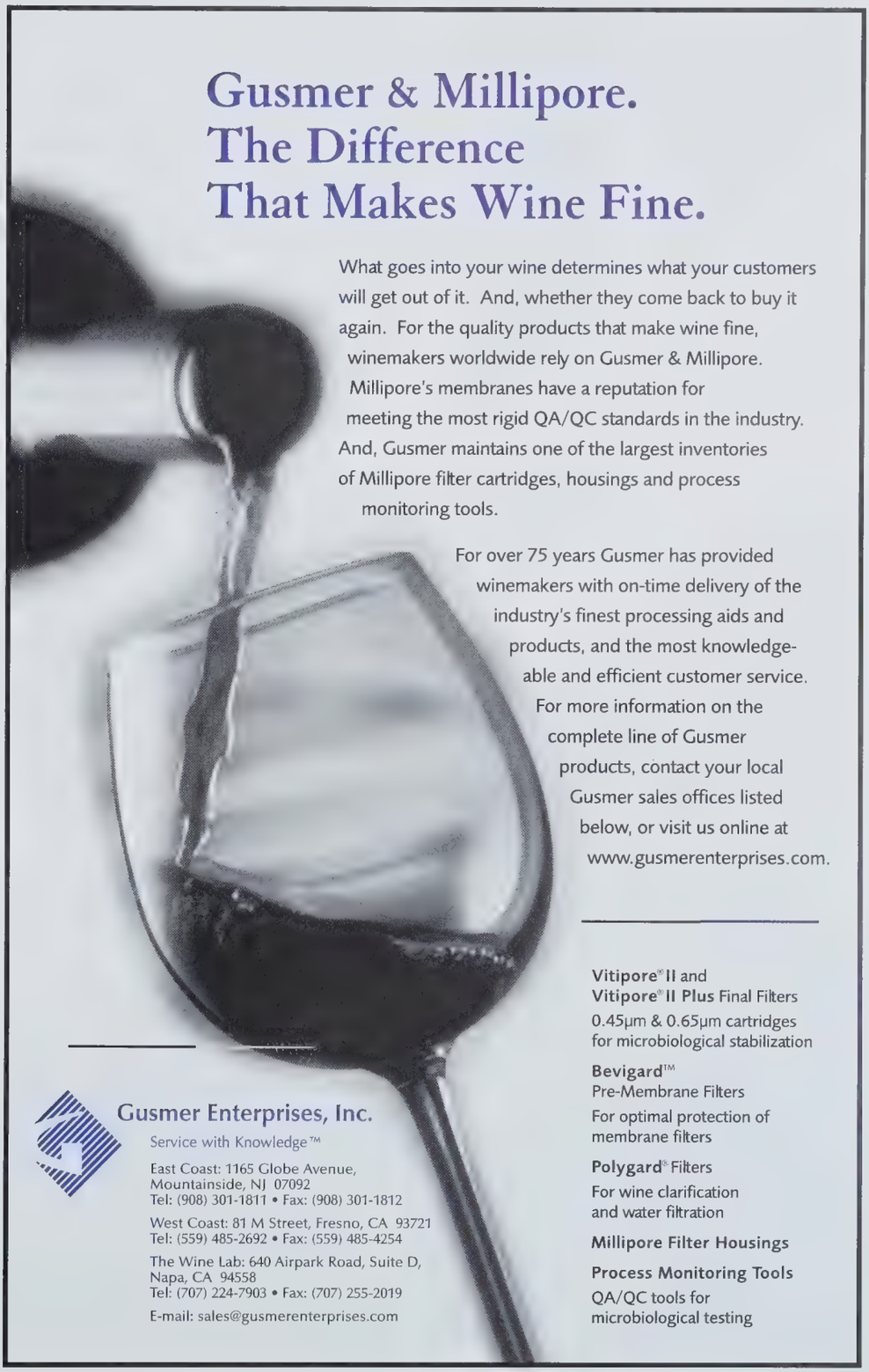
Average to excellent crops (5.6 tons per acre) were produced from the vineyard protected by one wind machine. Unprotected cold sites were partially killed to the ground (1.7 TPA). Two additional machines were installed in 2003, one at the 20-acre site that already had one wind machine and the other on the flat, unprotected site. The units cost about $25,000 each (installation and delivery). Five additional temperature recording stations were also installed.

2004–2005 results

The power of the wind machines is best illustrated by first examining a calm, clear arctic winter night with no machines. In Figure II, temperature recorders from December 26, 2004, show a short arctic blast beginning suddenly at 5:24 AM and ending by 9:00 AM. In the absence of a wind machine, the best sites never went below 3° to 4°F. The worst sites, by contrast, plummeted rapidly to –8° to –10°F. This pattern holds on **every** clear calm night regardless of season.

North slopes and hills at higher elevation are always warmer. Flat sites and those at lower elevation are always colder because cold air settles out at those locations. Probably the wind machines should have been turned on this particular morning.

In 2004, three wind machines were run on four of five cold nights (January 10, January 17, January 25, February 1, and February 16). On January 10, temperatures dropped suddenly below 0° at 6 AM for one hour. No wind machines were operated that night. On two other nights, the machines were run part of the night when skies cleared and winds fell. On the two worst nights, the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machines were run from sunset until sunrise.

A representative night in 2004 is shown in Figure III. Wind machines were started at 1:00 AM. Note how temperatures at the cold, flat site jump and follow the pattern of the higher temperatures at the frost-free sites instead of mirroring the lower readings at the unprotected cold site.

Two machines were run at the 20-acre protected, cold site, but the same level of temperature increase was not achieved. However, in each case, the wind-machines reduced both the intensity and duration of the cold episode on protected sites. On the two protected sites, above average crops were harvested (5.1 TPA); on the remaining unprotected site, vinifera vines were again killed to the ground (0 TPA).

In 2005, three machines were run an equal number of nights as in 2004, with the coldest night being January 27/28, 2005. In Figure IV, the powerful effect of just one wind machine near a warm site is evident. The machine was started at sunset, and by sunrise, the temperature was 15° above where it would have been on a night without the machine running.

In one protected flat, cold site, temperatures were held to a –5°F average; in the poorer protected cold sites a –9°F average was held for eight hours. In unprotected cold sites, temperatures fell from –12° to –15°F for eight hours. The best sites, by comparison barely fell below 0°F even for a short time and **without** a wind machine running.

Given the choice, a grower in the eastern U.S. should always plant vinifera on the premium sites not requiring a wind machine, but there are just not that many sites, and they are not always easy to identify before planting.

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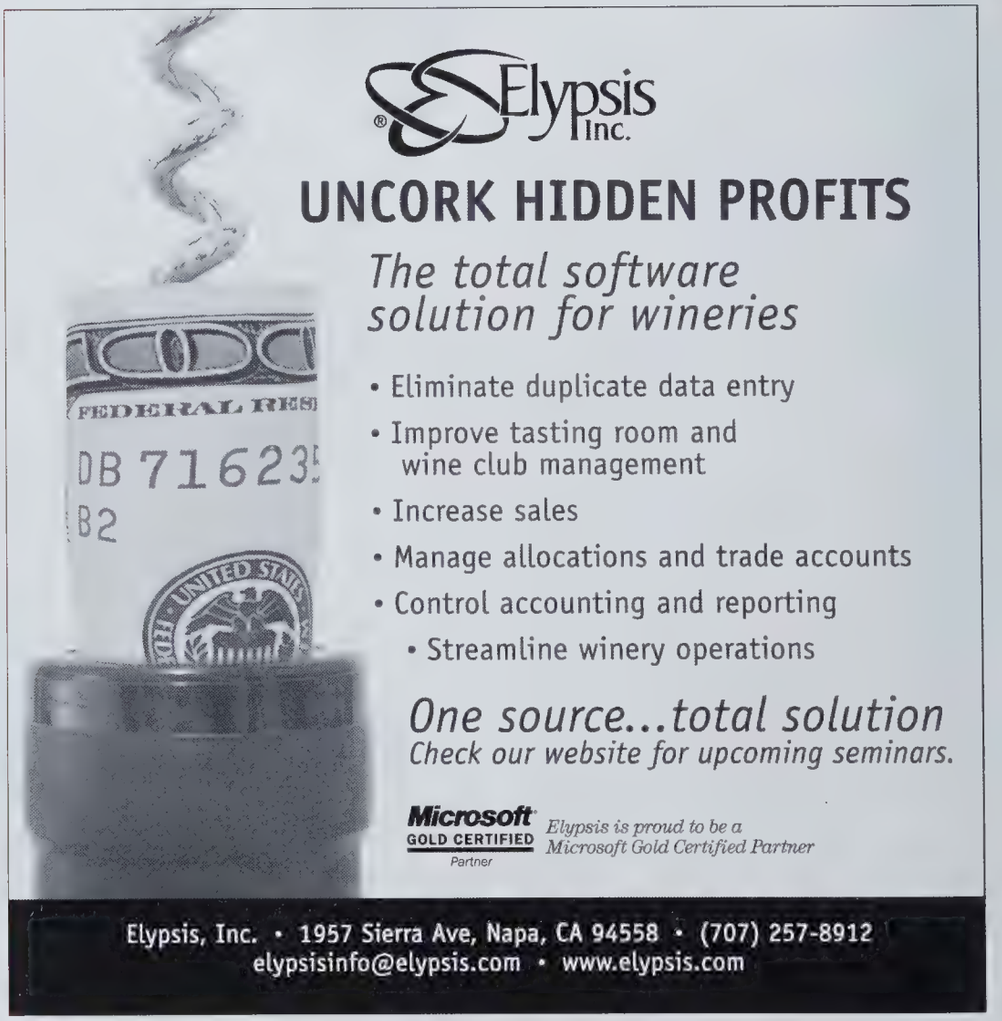
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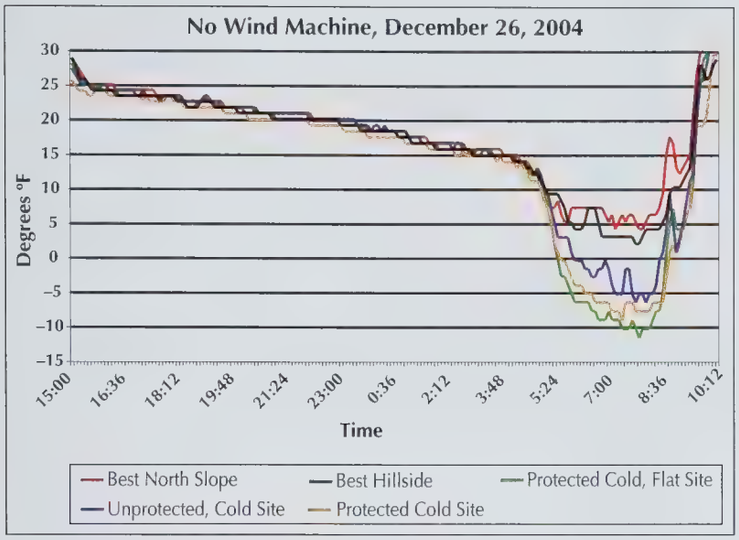


Figure II. The Morning After Christmas: to run or not to run — Temperature every six minutes at five sites on December 25–26, 2004. Wind machines were not run at any sites. A snapshot of undisturbed air in winter shows a 10–15° premium accrues to the best vineyard sites on calm, clear nights. It also underscores the rapid responses needed to run the machines precisely when needed.

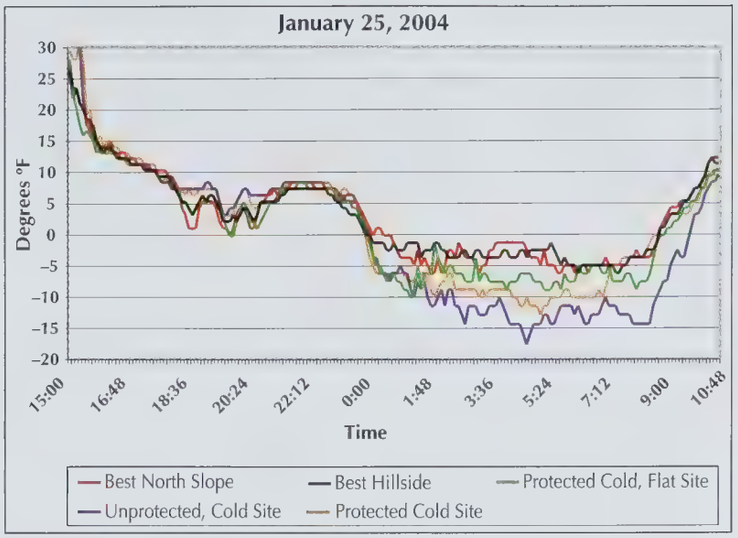
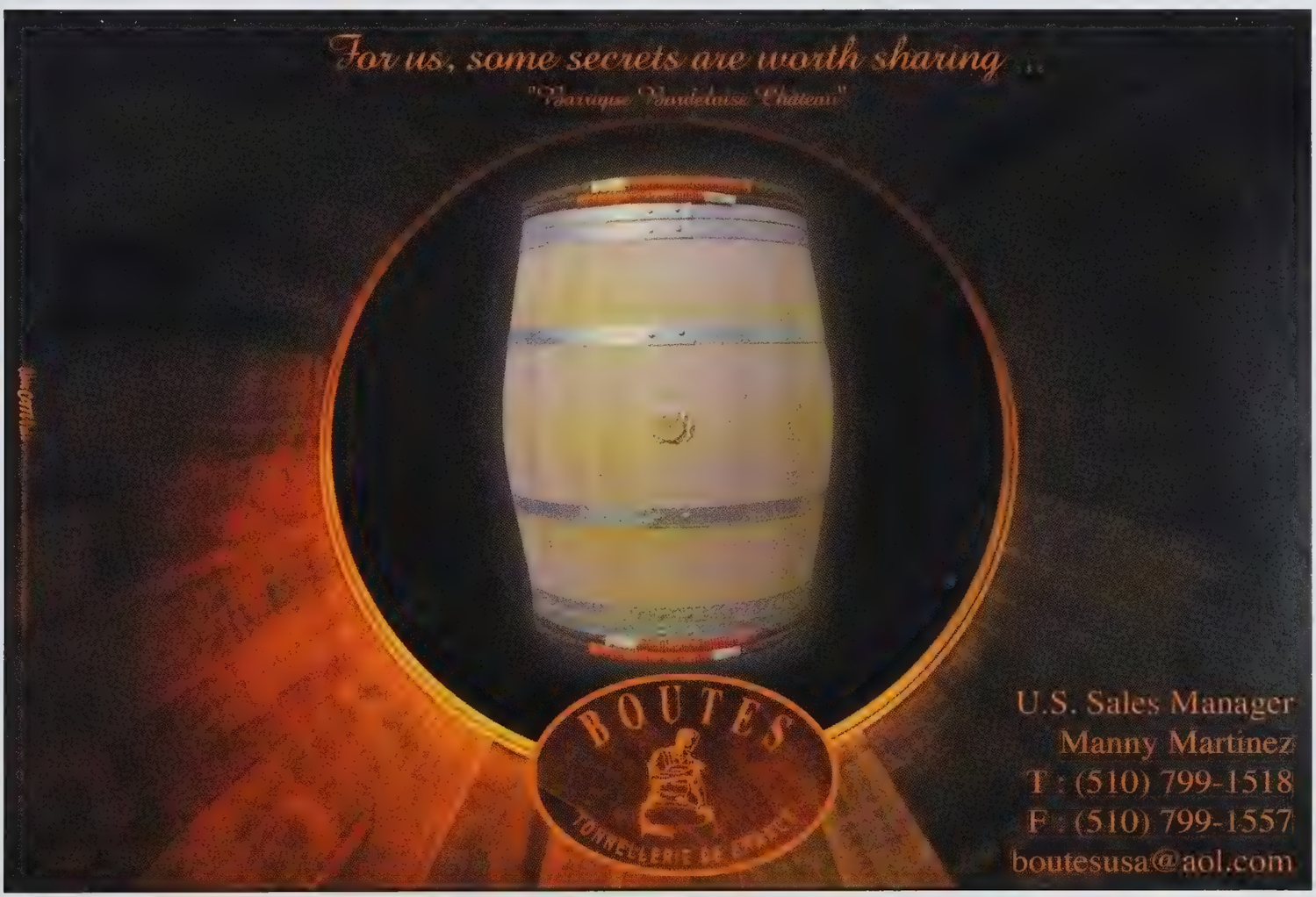


Figure III: The Standard Night — Wind machines started at 12:30 A.M. and ran until daybreak. The most pronounced effect is to eliminate the "oil pan sump effect" in the two protected sites.

There were several nights in 2004/2005 that we missed running the machines. One is shown in Figure II and another in Figure V. On January 23, 2005, we did not start the machines until 7:30 PM, after temperatures were already at –10°F. By 10:30 PM, the episode was all over anyway because clouds came in and the winds picked up.



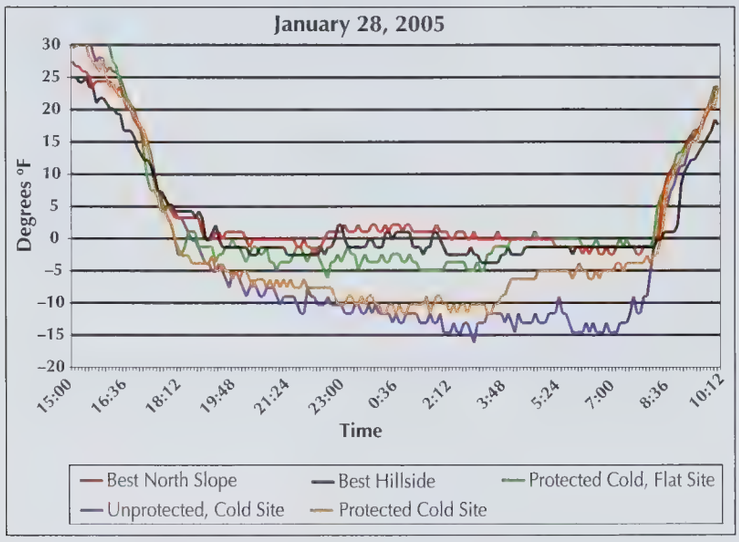


Figure IV. The Coldest Night of 2005 — Temperature readings every six minutes at the five sites on January 27–28, 2005. The Protected Cold, Flat Site wind machine was started at sunset and two units were activated at the Protected Cold Site.

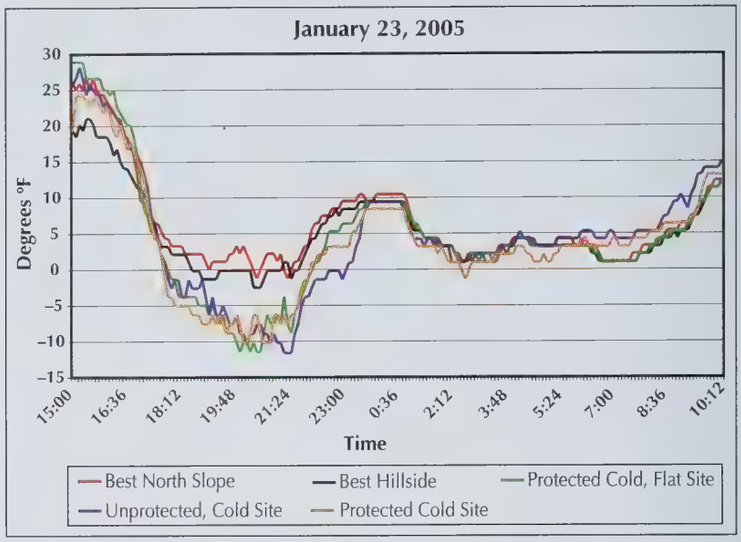


Figure V: A Cold Night with Machines on Late — Machines started at 7:48 P.M. and shut down when wind picked up at 10:30 P.M. on the night of January 23, 2005.

Starting the machines in a timely fashion at temperatures **above 0°** is critical to using the machines successfully. In 2005, unprotected cold sites yielded 1.9 TPA. The flat, cold site with one machine yielded 3.9 TPA. The multi-machine cold, protected site yielded 5.7 TPA.

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Conclusion

The most commonly asked questions about the wind machines are: "Do they work?" and "How much do they raise the winter low temperature?" In our best site, currently protected by one 165-hp unit, the wind machine raises the temperature 8° to 12°F on up to 15 at-risk acres on the coldest January nights when it is started early.

On poorer sites, even with multiple machines, a smaller temperature increase is to be expected (3° to 4°F), although the machines clearly lessen the time that the vineyard spends at the night's lowest temperatures.

On a 10-acre site, with winegrapes valued at $1,500/ton, avoiding a one-time 1.6 TPA loss from winter kill will recover the initial investment. On any **one** of the coldest nights between 2003 and 2005, each machine paid for itself.

Our experience in Ohio clearly demonstrates that wind machines make an important difference in successful grapegrowing in the region. Other regions suffering from winter injury and frost damage would do well to investigate them further. ■

Gene Sigel is an economist by training who entered the grapegrowing profession in April 1994 as vineyard manager at Debonné Vineyard's 55 acres in Madison, Ohio. The farm has grown to 110 acres of vines spread over five square miles and protected by four Orchard-Rite® *wind machines. Direct inquiries to author at srv@intermessage.com.*

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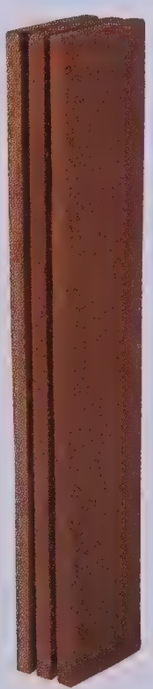

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OVERVIEW

2005 Pierce's Disease Research Symposium

BY Kim Waddell, Executive Director, American Vineyard Foundation, Napa, CA

The fifth annual Pierce's Disease Research Symposium (December 5–7, 2005 in San Diego, CA) was organized and hosted by The California Department of Food & Agriculture (CDFA). "The 2005 symposium was the most exciting and productive meeting ever, and both research and industry representatives came away with a real sense of progress and, more importantly, a real sense that some potential solutions to the threat of Pierce's disease (PD) are visible on the horizon," reports Pete Downs, chairman of the Pierce's Disease/Glassy-Winged Sharpshooter Board (appointed by CDFA), and vice-president of governmental affairs for Jackson Wine Estates (Santa Rosa, CA).

Five major areas of research were profiled in oral and poster presentations; including Crop Biology and Disease Epidemiology, Vector Biology and Ecology, Pathogen Biology and Ecology, Pathogen and Disease Management, and Vector Management. Below are highlights of a few research programs within each area and does not attempt to fully capture the breadth or depth of all research efforts presented. Proceedings of the Symposium are available online at: http://www.cdfa.ca.gov/gwss/ResearchSymposium/gw2005symp.htm.

Crop Biology / Disease Epidemiology

In crop biology and disease epidemiology, one of the persistent questions regarding PD and its host plants is how the bacteria that causes PD, *Xylella fastidiosa* (*X.f.*), behaves inside resistant or tolerant plants in contrast to its behavior in susceptible plants.

In nature *X.f.* is found in a large number of host plants that are essentially free of any disease symptoms, so it has been postulated that *X.f.* may be a harmless endophyte — an internal dwelling bacteria that has little or no effect on the plant's health or welfare — while in other plant species or varieties, the bacteria has a significant or even lethal effect on the health and productivity of the plant.

Researchers have developed a transgenic version of *X.f.* that carries a green florescent protein which allows researchers to be able to view and characterize the movement of live *X.f.* inside of plants, in hopes of understanding more about the growth, spread, and impact of *X.f.* colonization in different plants.

Variation in plant architecture, specifically within the xylem — where *X.f.* almost always is found — has been a focus of several studies. Differences in the xylem vessels, especially in the membrane structures that segregate and facilitate the movement of proteins, minerals, and fluids in the plant all have been examined as potentially important factors for how the bacteria moves and spreads inside a plant.

In some plants, the bacteria appears to move rapidly and readily through a plant without having to digest or break down cell walls, while in other plants, the movement and spread of the bacteria appears to be slow and compartmentalized. Gaining an understanding of how *X.f.* interacts with its host plants will help researchers better understand what physiological mechanisms and structural attributes within plants may determine their potential vulnerability or resistance to PD.

Research on the epidemiology of PD is underway and new hypotheses are being generated as researchers look at the pattern of disease spread and its severity in regions that have been infested by the glassy-winged sharpshooter (GWSS) over the past 10 years.

Researchers have identified a number of factors that appear to influence the spread and severity of PD in vineyards; including the spatial orientation or proximity of preferred host plants for GWSS and other sharpshooters, movement of GWSS populations throughout the year, timing of *X.f.* infection within the growing season, whether the infections being spread by GWSS were the result of primary spread (*X.f.* coming from outside-the-vineyard sources into the vineyard) to or secondary spread (*X.f.* being spread vine to vine inside the vineyard), and effect of dormant season (over-wintering) survival of *X.f.*

Now researchers are beginning to understand interactions between these factors and are developing models that will eventually provide growers with ways to reduce their risk of loss to PD, provide researchers with the ability to make reliable predictions of disease spread, and provide policy makers with greater confidence to allocate appropriate levels of resources for controlling that spread.

Research efforts in creating PD-resistant winegrapes are moving forward on two fronts. Researchers have taken advantage of modern molecular genetic mapping techniques to identify and locate genes that confer resistance to PD. These genes, many of which are found in native American and non-*Vitus vinifera* grape varieties, can then be cloned and eventually introduced into susceptible grape varieties via genetic engineering.

Mapping these resistant genes also provides researchers with the ability to generate genetic markers — tools that can be used in a grape breeding program to facilitate rapid screening of grape seedlings for PD (and other pest and diseases) resistance. One such marker-assisted breeding program is underway with high quality *V. vinifera* being backcrossed with highly resistant wild grape species. In one line of crosses with *V. arizonica/candicans* parentage, the third generation progeny have 87% *V. vinifera* parentage and are still PD-resistant, with the expectation that these new plants will have high fruit quality suitable for wine production.

Another research effort is underway to evaluate the effectiveness of different antimicrobial peptides (AMPs) as a potential source of PD resistance. These molecules have been found to be effective against a number of bacterial diseases (like PD and crown gall) and have been successfully introduced into grapevines via genetic engineering.

Related research is evaluating the potential for these peptides and other

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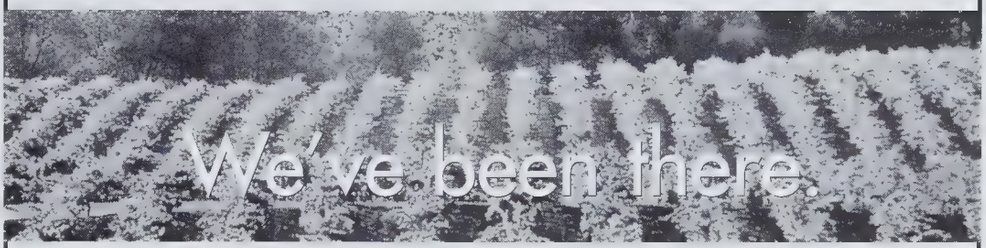

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protein molecules to be transported across grafts between rootstocks and scions. This has obvious importance as researchers investigate the potential of transgenic rootstock being used to confer disease resistance to conventional scion materials, and the reverse — resistant transgenic scions being grafted onto existing rootstock materials.

These areas of research are exciting and hold a great deal of promise because they are likely to provide the platform for integrating the most effective forms of resistance into grapevines. Given the diversity of varietals and clones used by the wine industry which are grown across a broad range of growing conditions, it is likely that multiple approaches or forms of introduced resistance will be needed to successfully protect grape production from the threat of PD.

Vector Biology

Central to managing the threat of PD and its spread in vineyards is the need to control insect vectors of the disease, specifically GWSS. Understanding GWSS biology has been particularly challenging for researchers in part because of the insect's ability to utilize a wide array of host plants, its ability to disperse over great distances, and the fact that the species does not have nor responds to any sort of pheromone or other chemical attractants. Further complicating the issue is the fact that many plants in the California landscape that are also reservoirs of *X.f.* do not exhibit signs of disease, again making it difficult to observe, in the field, where or when an insect might acquire *X.f.*

The prevalence of GWSS infected with *X.f.* and the rate of transmission in vineyards and neighboring regions is fundamental to understanding PD epidemiology. Researchers are beginning to piece together a picture that shows that the proportion of GWSS populations that are infected with *X.f.* increases over the course of a growing season.

Researchers have been able to determine experimentally the mechanism of *X.f.* inoculation by GWSS by using the same transgenic version of *X.f.* that carries a green florescent protein mentioned earlier that allows researchers to be able to view and characterize the movement of live *X.f.* inside of plants. This research tool, utilized with specially modified microscopes and video equipment has allowed researchers to finally observe how the insect might introduce the bacteria into a plant that results in the spread of PD.

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GWSS utilize a large number of host plants for feeding and for laying their eggs, many of which may be sources of *X.f.* ; consequently tracking the movement of GWSS in a complex landscape and determining what factors might influence their dispersal patterns is an important objective.

Fortunately, researchers have developed a marking technique using a variety of inexpensive proteins (derived from egg whites, milk, and soybeans) that can be individually sprayed (much like a pesticide application) onto insects found in vineyards, orchards, and fields. These insects, when later recaptured, can then be readily screened for the presence of one of these proteins and their origins or previous feeding habitat can be determined — providing an important bit of information about GWSS dispersal patterns that researchers previously could only speculate about.

One of the most successful aspects of controlling GWSS populations over the past five years has come through research efforts that have identified effective chemical controls and related vector source habitat management. Insecticidal treatments of host plants in the agricultural and neighboring areas, and the removal of plants preferred by GWSS and other sharpshooter populations has significantly reduced the pest numbers in nearly every infested region of California.

One of the more difficult areas to treat or manage are urban and suburban areas — with a broad range of ornamental host plants coupled with a high density of humans — which are

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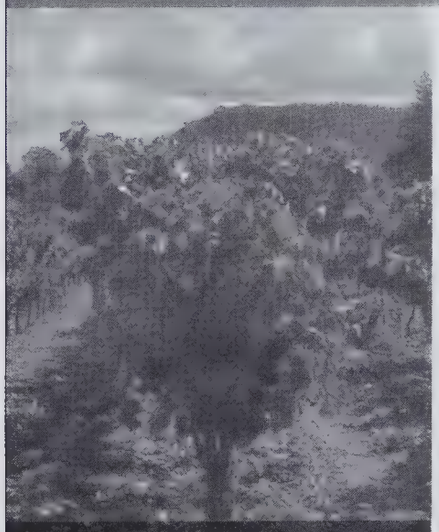

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not areas amenable to large-scale chemical treatments or selective removal of host plants. Researchers have begun to explore the role of these habitats as potential sources of GWSS that replenish populations that have been eradicated or greatly reduced in nearby agricultural areas.

Given the limitations for chemical control, biological control agents such as beneficial insects have been studied for use in urban areas. Recent research reveals that these urban settings may be ideal for supporting over-wintering parasitoid species that are critical for attacking GWSS populations in the spring — a time when over-wintering GWSS populations typically escape predator and other natural enemy pressures and whose numbers can often determine the size and impact of subsequent GWSS generations during the critical growing season.

These new findings and techniques/tools developed to understand more of the biology of GWSS are promising, but much more work needs to be accomplished before researchers and managers can predict the movement and impact of GWSS populations relative to the spread of PD. Nonetheless, it appears that many fundamental obstacles to understanding this insect have been overcome and it is expected that research progress will accelerate over the next few years, yielding critical information that will help managers anticipate the movement and impact of this insect throughout its range in California.

Pathogen Biology and Ecology

As discussed in the first section, one of the persistent questions regarding *X.f.* involves its behavior in both resistant and susceptible plants. It is thought that this variation in behavior, or relative virulence, is a key to understanding the pathogen's biology and eventually also a key to managing plant response to presence of *X.f.* within its tissues.

Research in this area reveals that the impact of *X.f.* primarily depends on movement of the bacteria within a plant. If the bacteria population grows and moves readily throughout a plant which results in extensive xylem vessel blockage, disease symptoms will be expressed. However, researchers have observed that patterns of clogged vessels due to high numbers or concentrations of *X.f.* in a given area are actually detrimental to the bacterial colony; *X.f.* cells that cannot escape crowded vessels will die.

Recent research reveals that active movement (such as lateral movement across plant vessel membranes and

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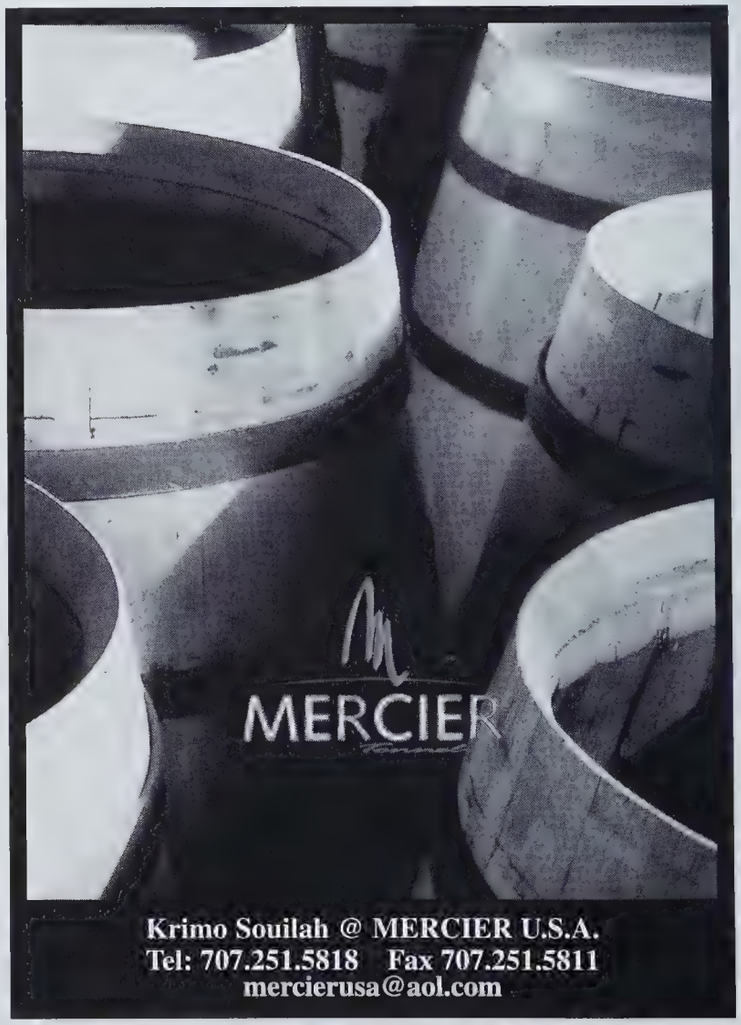

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beyond the confines of a single xylem vessel) of *X.f.* cells can only happen when the *X.f.* cells are not packed tightly together. Researchers have looked extensively at *X.f.* physical attributes in efforts to understand what facilitates movement of *X.f.* within a plant.

Other research efforts have focused on environmental conditions inside and outside a host plant that might influence establishment of *X.f.* One lab has determined that the presence or absence of other bacteria and microbes inside a plant affects establishment of *X.f.* Specific combinations of these microbe species are routinely found in plants that are disease symptom-free despite presence of *X.f.* while other combinations are often found in plants that exhibit disease symptoms. These findings are preliminary, but may lead to novel biological control efforts utilizing naturally occurring microbes to mitigate PD expression in target host plants like grapevines.

What is apparent with the research in this area is that understanding the genetic basis for *X.f.* virulence and infection is one of perhaps only three or four research thrusts that is most likely to lead to a sustainable and long-term solution for PD management. Given the genetic diversity exemplified in the numerous strains of *X.f.* and ability of many bacteria to rapidly evolve, researchers believe a solution based on this information must target highly conserved and commonly shared genetic information (among the strains) for vulnerabilities that can be exploited and manipulated against *X.f.* This will be

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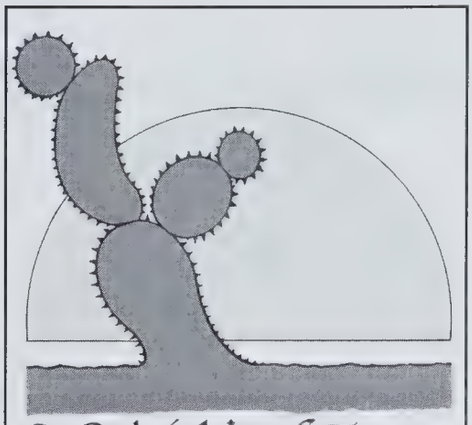

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a significant challenge but progress appears to be well underway.

Pathogen / Disease Management

There are several management strategies that have been or continue to be developed and this research area utilizes and applies many tools and research findings from other areas of research discussed above. Many initial efforts to manage *X.f.* and PD have focused on well-known chemical and cultural control methods; this was a practical and obvious approach that, if successful, would lead to a relatively quick and inexpensive solution that growers and managers could use against *X.f.* and PD.

Unfortunately, a variety of bactericides and other compounds known to be effective against various bacteria, whether applied as preventatives (prophylactic) or as cures (therapeutic) have been shown to be ineffective against this bacteria in the field under "real world" conditions. While there are numerous reasons why these did not work, the primary challenge appears to be that *X.f.* is difficult to selectively isolate and kill as an inhabitant of the xylem in plants — without harming or killing a plant in the process.

Consequently, several of the current strategies under development involve novel approaches and utilize the most modern scientific tools available. Several researchers have focused on developing transgenic organisms or proteins that specifically target *X.f.* in plant tissues and inactivate or kill the bacteria.

Some researchers are focusing on introducing proteins that interrupt essential interactions between *X.f.* and its host plant. These proteins would be designed to be delivered by the grapevine which would require that the scion or rootstock would need to be genetically engineered in order to express the protein in question. An alternative mode of delivery of the proteins, for example by an external spray application, poses the challenge of how the proteins would reach their targets inside the xylem.

One research group has developed transgenic bacteria engineered to deliver an anti-*X.f.* product that inhibits transmission of *X.f.* by its insect vectors. This specific bacterium occupies essentially the same ecological niche as *X.f.* — it is found in the foregut and mouthparts of insects and in plant tissues including the xylem. It has been evaluated for

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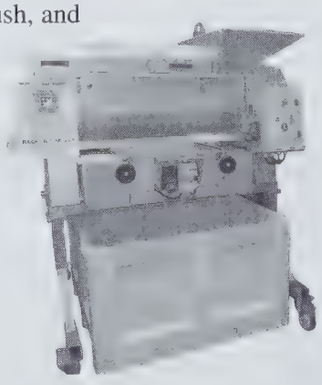

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release into the environment where insects would be expected to acquire them during normal feeding. Research on this particular management system is perceived to be at the most advanced stage of development relative to others involving genetic engineering.

Other major research efforts involve exploring several naturally occurring endophyte species (microorganisms that inhabit plants but unlike pathogens like *X.f.*, they do not appear to harm the host plant) as potential biological control agents against *X.f.* To date, endophytes examined do exhibit varying levels of effectiveness against *X.f.*, but none exhibit the effectiveness of transgenic versions that have been developed. However, genetic engineering of microbes or plants poses some unique market and regulatory challenges for the grape and wine industry that cannot be ignored, even in the pursuit of a solution for PD.

Other control strategies involve continuing research into identification of alternative host plant species (such as ground cover plant species and commercially important plant species like almonds) as potential reservoirs of *X.f.* strains that can infect grape. Identification of these host species may provide opportunities for controlling or limiting insect vectors from acquiring *X.f.* and inoculating grapes and other commercial crops.

One important area of research that contrasts with much of the research described so far is where researchers are looking at the grapevine for innate or built-in genetically-based mechanisms for controlling PD. Research includes looking for ways that the plant can block and suppress susceptibility to the disease, and activate innate immunity responses. Much of this research involves characterization of the host plant response to the infection by *X.f.* by exploring which genes are activated, and what protein products are expressed, especially with comparisons of susceptible and resistant plant types.

Locating and mapping the genes within the grape genome contributes critical information for use with the marker-assisted breeding program discussed earlier. From this research, tools for genetic and biochemical analyses are developed and intervention strategies utilizing either biotechnological (genetic engineering) or cultural approaches can be evaluated.

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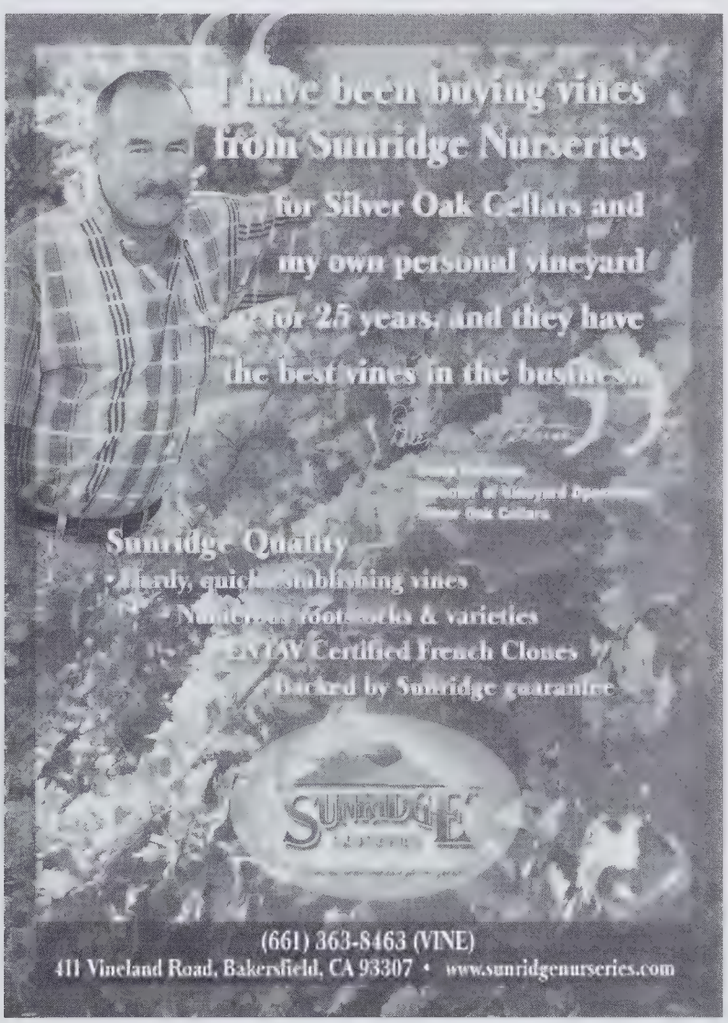
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This research area of pathogen and disease management represents the forefront of research that will lead to options for controlling the bacteria and the disease. Many of the researchers have turned to biotechnology/genetic engineering to develop tools that facilitate their understanding of the genetic-based vulnerabilities of *X.f.* and its hosts. As a suite of powerful analytical tools, biotechnology and molecular genetics are revolutionizing the researchers' abilities to address the challenges of PD and other plant pathogens.

It may be that the first opportunities for successfully controlling PD may include genetically-engineered plants or microbes, but both the research and industry communities will need to continue pursuing management strategies that do not require the adoption of biotechnology; there will be segments of the grape and wine industry who will not want to utilize these tools regardless of their efficacy.

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Vector Management

The early research success in identifying effective chemical controls for GWSS, coupled with a coordinated large-scale eradication program involving multiple agricultural sectors like the citrus and nursery plant industries has led to a significant reduction in the numbers of GWSS throughout the infested areas of California. While this is a wonderful success story in our efforts to control GWSS populations, it is critical that policy makers, industry, and researchers alike understand that the threat of GWSS has not gone away and that we need to remain proactive in managing this threat.

Much of the current research has been dedicated to efforts identifying effective biological control agents such as parasitoid wasps and flies that could reduce GWSS numbers at various times of the year. There has been considerable success in understanding the biology and ecology of several wasps in the genus *Gonatocerus* which are highly effective at attacking GWSS eggs late in the season.

However, there still remains a need for a cold-tolerant (spring time) parasitoid fly or wasp that could be used to attack the GWSS eggs

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deposited by over-wintering adults. Survival of this first generation of GWSS eggs early in the growing season strongly influences the number and impact of subsequent GWSS generations, so researchers are looking in regions like Argentina and Mexico for potential candidates. Some species are already being evaluated for their appropriateness for release in this country in quarantined research facilities in state, but researchers are hoping to identify additional species for evaluation.

Other potential control strategies being researched include identification of other "sources of mortality" for GWSS populations. These include fungal pathogens and insect predators that can attack different GWSS lifestages. However, GWSS populations appear to be less vulnerable to many common pathogens because of the nature of their piercing/sucking feeding behavior which limits their exposure to pathogens aside from those that might be found in the plant xylem. Nonetheless, a few pathogens have been identified and they have been screened for potential toxins that might be utilized as biological control agents for GWSS populations.

One of the more significant presentations made at the symposium was an overview of the vector management efforts with the nursery industry. Over 90% of the nursery production occurs in GWSS-infested areas of California, yet half of the production from these nurseries are shipped into un-infested areas in central and northern California. At this time, this poses the greatest known risk for the accidental introduction of GWSS into these areas.

The CDFA, nursery industry, and grape and wine industry are all well aware of this and have worked diligently to minimize the risk by implementing and following a strict plant inspection and screening program at both the nursery and shipping destinations. However, this level of screening and treatment is quite expensive, averaging approximately 0.30 dollars per plant pot or about $10 million per year for the nursery industry excluding the cost of rejected shipments or the cost to the state in managing aspects of the program.

The primary concern with these shipments has been GWSS egg masses that might elude the inspection process. Research associated with these efforts have determined that the pesticides carbaryl (a methyl carbamate) and fenpropathrin (a pyrethroid) appear to very effective in killing eggs when used as a prophylactic treatment of shipped plants. There is hope that use of these egg-killing treatments will reach a level of efficacy that will allow the industry and state to forego human inspection protocols that are both expensive and time consuming.

However, it will require of the grape industry a great deal of trust for them to be willing to risk the introduction of plants from infested areas into un-infested areas that have valuable grape production acreage. The reality is that the current screening protocols are not financially sustainable, so it will be important for the two industries and the state to develop an effective plan of action that addresses the concerns for all involved. ■

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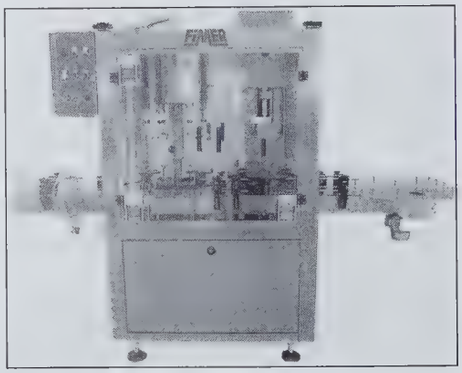

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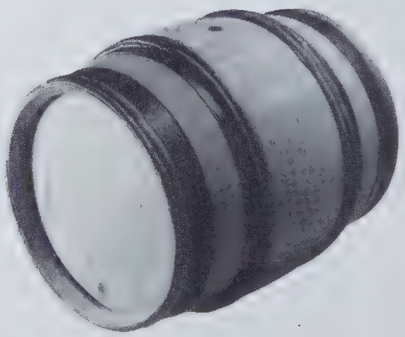

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Continued from page 34

there was a mildew problem during the prior season.

Fanucchi mixes other registered fungicides along with the mineral oil, but far less frequently than Cuneo. He feels that Stylet-Oil provides sufficient control. But if weather conditions promote high powdery mildew pressure or if there is an outbreak of powdery mildew, one or two applications of fungicide are made along with the mineral oil. It has never been necessary to do this more than twice per season.

He applies the mineral oil at 14-day intervals, but will stretch the interval a bit if the weather heats up. Fanucchi does that to avoid heat damage to the foliage, but also because powdery mildew pressure is low during heat events (above 90°F). Fanucchi's vineyards have a northwest-southeast row orientation, which exposes the vines to direct sunlight during the afternoon.

Fanucchi tries not to spray if temperatures reach 87°, because that usually means that temperatures in the afternoon will be outside his comfort zone. If the weather service forecast is 100°F or higher, he will hold off all spraying until the heat wave subsides. He will then increase irrigation and wait one or two days after the heat event has passed before resuming oil sprays to allow the vines to rehydrate. While all of this precaution may seem daunting, it should be noted that sulfur requires similar precautions against application during hot weather.

Fanucchi applies the product with a Turbomist sprayer fitted with a tower and feels that he gets good coverage with that system. He applies a 1% emulsion of oil at rates varying from 75 to 150 gallons of water per acre. The lowest volume is applied early in the season and the highest volume applied late in the season if there is a mite infestation. The mineral oil is applied from budbreak until the last berry has gone through veraison.

In the cool spring, he feels that the mineral oil is more effective than sulfur, because unlike sulfur, mineral oil does not need to be volatilized to be effective. Likewise, there is no concern of residue on the fruit affecting wine quality, so he is not afraid to apply mineral oil a bit later in the season than he would sulfur.

Fanucchi's efforts at eliminating sulfur have been successful. He has had mildew outbreaks (especially in 2005 which was a high-pressure year), but feels that these outbreaks are similar in incidence and severity to sulfur-wielding neighbors.

Fanucchi has seen significant benefit of mineral oil against insect pests. The mineral oil regime suppresses both leafhopper and mite populations. He has had some success at using mineral

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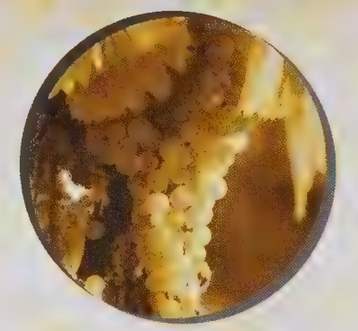
oil for mite control, but has found that, while it suppresses mite populations, it does not completely eradicate them. He has had success against mites by distributing predatory mites in his vineyard a few days after a mineral oil application.

Fanucchi feels that beneficial mites are less affected by the oil spray, as they are predominantly found in more sheltered portions of the leaves. All-in-all, he is optimistic that the mineral oil program will eliminate his need for chemical miticide treatment.

Fanucchi cautions against applying mineral oil on severely water-stressed vineyards. He has observed some leaf scorch in vineyards that have been temporarily water-stressed. To avoid the problem, he attempts to maintain his vineyards between –12 and –13 bars of midday leaf water potential. ■



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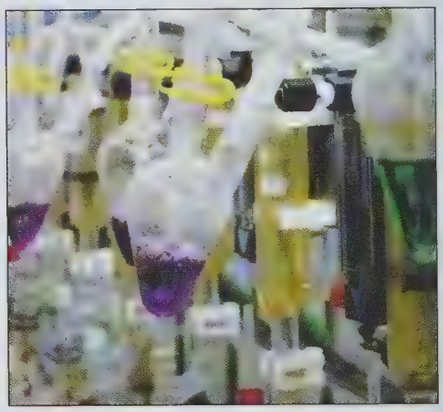

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Korvan by OXBO

Korvan grape harvesters are American-made and backed by a commitment to customer service and parts availability. This commitment enables Korvan to be the best-selling grape harvesters in the U.S. winegrape, raisin, and juice market for the past six years.

For 2006, OXBO introduces the new Korvan 4012 and the most extensive line of Korvan grape harvesters ever. The 4012 is a multi-function grape harvester designed to harvest or spray, and perform other vineyard tasks. Now, there is a Korvan harvester to meet every grower's needs.

Using grower suggestions, the proven design of the Korvan 3016XL has also been improved for 2006. The 3016XL now features easy-change rod holders, improved lower stick kickers, improved steering lights, and two-wire hydraulic hoses throughout the machine.

All Korvan harvesters utilize a bucket conveyance system and soft-touch bow rod harvesting system that gently carry grapes to the gondola, giving clean, whole fruit. Because Korvan doesn't drag the grapes, Korvan harvesters pick the fruit winemakers love.

With Korvan grape harvesters, the vMech system and GreenTech sprayers, OXBO's complete line of Vineyard Solutions provides growers with all of the quality products needed for today's vineyards.

For more information, contact:
Korvan by OXBO
270 Birch Bay Lynden Rd.
Lynden, WA 98264
toll free: 888/6-KORVAN
tel: 360/354-1500; fax: 360/354-1300
e-mail: korvan@korvan.com
website: www.korvan.com

PLEASE SEE OXBO INTERNATIONAL AD, PAGE 49.

Premiere Viticultural Services

Premiere Viticultural Services announces the release of PremiereVision, Version 3.0, a web-based viticultural database application, which allows a grower or winery to efficiently monitor and manage all critical viticultural information, from planning through harvest.

Designed by viticulturists and grape growers, with input from leading wineries such as Cakebread Cellars, the web-based PremiereVision application provides all levels of staff with a simple, powerful, and cost-effective tool to better manage performance of vineyards.

There's no need to invest in new hardware or software. PremiereVision provides the necessary tools to use with existing computers and internet connections. You can begin using the Premiere application from any Internet browser. Premiere manages the security and backups to keep your data totally safe and secure.

New improvements in version 3.0 include enhancements such as a budgeting tool, strengthening the robust planning module, full loop of spray work orders through to pesticide use reporting, statistical crop estimation, phenology-based harvest date prediction, and year-end summary reporting.

Version 3.0 PremiereVision is available in three levels: PremiereData, to manage all of your current and historical information; PremiereDecision, which adds work orders for vineyard inputs and the crop estimation tool; and PremiereVision, for comprehensive viticultural planning and activity-tracking.

Premiere Viticultural Services currently provides the PremiereVision application and complete viticultural services to clients on several thousand acres in Napa and Sonoma counties. Premiere's clients have consistently experienced significant, cost-effective improvements in winegrape quality and relationships with winery/grower partners.

For more information, contact:
Premiere Viticultural Services
Steve Matthiasson, President
855 Bordeaux Way, Ste, #100, Napa, CA 94558
tel: 707/261-8750; fax: 707/255-2044
e-mail: steve@premierevit.com
website: premierevit.com

PLEASE SEE PREMIERE VITICULTURE AD, PAGE 49.

Vintage Nurseries

Vintage Nurseries is one of North America's largest producers of dormant field-grown benchgrafts. Vintage Nurseries' advanced facility allows the greatest quality control in the industry today. Customers quickly discover that one call is all they need to receive the best value with highest quality grapevines at the most competitive price-point in the industry. Vintage Nurseries also includes hot water-dipping, designed to eliminate vine mealybugs and other pests and pathogens, at no extra cost.

Vintage Nurseries also produces greenhouse-grown benchgrafts, rootstock rootings, own-rooted vines, and cuttings. Located in California's southern San Joaquin Valley, Vintage Nurseries propagates all plants in one of North America's best climates for a grapevine nursery.

Vintage Nurseries announces a record-setting 2006 speculation crop, thanks to an aggressive growing program and an extremely high percentage of takes in the field. Vintage Nurseries makes "speculation growing" a key part of its business, enabling customers to call if necessary at the last minute to place orders.

The Spring 2006 speculation crop includes many popular varieties including Cabernet, Syrah, Pinot Noir, Merlot, Malbec, Chardonnay, Sauvignon Blanc, Pinot Blanc, Gewurztraminer, and more.

All customers and industry professionals are welcome to visit the facility and growing grounds.

For more information, please contact:
Vintage Nurseries
Northern CA, Western U.S.:
Nicholas Podsakoff
tel: 209/456-0697
Central coast CA, Eastern U.S.:
Dave Haggmark
tel: 805/391-0905
South Valley wine grapes, table grapes:
Mike Enns
tel: 661/747-1582
Shipping and billing issues:
tel: 800/499-9019

PLEASE SEE VINTAGE NURSERIES AD, PAGE 83.

OXBO International Corp.

vMech System

OXBO's vMech System is a family of U.S.-made vineyard mechanization equipment ideal for growers looking for high fruit-quality, increased vineyard control, and to maintain competitiveness in today's market. The vMech system features three platforms that carry interchangeable mechanization attachments: the 2220 dual arm trailor-style Tool Carrier, 1220 dual arm tractor-mount, and 1210 single-arm tractor-mount.

The vMech system allows vineyard managers to mechanize the most labor-intensive cultural practices in today's diverse vineyards, with both rotary and sickle bar pruners, from pre-pruning to finish-pruning.

Growers can mechanize the normal labor-intensive dormant-season spur-pruning operation. The system uses precision pruning to maintain vine shape and capacity requiring only minimal hand follow-up to remove loose brush and make final cuts around trellis obstructions.

All attachments are designed with a quick-attach for convenient setup on either platform. Currently, attachments for finish-pruning, pre-pruning, shoot/cluster thinning, fruit thinning, and hedging are available. Other attachments for leaf removal and cordon and trunk cleaning are in development.

With the vMech system, Korvan harvesters, and GreenTech sprayers, OXBO's complete line of Vineyard Solutions provides growers with quality products needed for today's vineyards.

For more information, contact:

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14344 S. Bethel, Kingsburg, CA 93631
tel: 559/897-7012
CA rep: **Greg**: 559/859-7268
e-mail: gberg@oxbocorp.com
website: www.korvan.com or www.oxbocorp.com

PLEASE SEE OXBO INTERNATIONAL AD, PAGE 49.

Turrentine Brokerage

For more than 30 years, Turrentine Brokerage has developed an unparalleled record of predicting wine business trends and helping clients to profit from them. If you deal with wine and grape supplies, if you need to buy or sell grapes or wines in bulk, you need Turrentine Brokerage.

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tel: 415/209-9463; fax: 415/209-0079
e-mail: info@turrentinebrokerage.com
website: www.turrentinebrokerage.com

PLEASE SEE TURRENTINE BROKERAGE AD, PAGE 27.

California Seed & Plant Lab

California Seed and Plant Lab (Cal-SPL) located near Sacramento (CA), offers plant disease testing and genetic identification of grapevine varieties. The firm was established in 1995 and employs a highly-qualified technical staff (Ph.D. and MS scientists).

Disease diagnosis: Cal-SPL offers 17-virus PCR test to cover all viruses known to be present in California vineyards. Growers can identify healthy vines and start new plantings from the healthy vines. Other economically important diseases including young vine decline (*Phaeoacremonium spp*) are also identified.

Virus elimination: Cal-SPL offers meristem services to eradicate virus infections from your favorite variety.

Soil health: Cal-SPL also offers analysis of soil and enumerates beneficial microorganisms to such important pathogens as *Agrobacterium* (crown gall) and *Cylindrocarpon* (root rot). The analysis helps growers to choose a suitable organic amendment or compost tea to incorporate into soils for maximum yields.

Variety DNA identification: Genetic testing includes fingerprinting of varieties with 8-marker DNA test. Fingerprint is compared with the varietal database (Cal-SPL has all varieties grown in California in the database). Fingerprinting service can also provide genetic profiling for patent applications.

For more information, contact:

California Seed & Plant Lab
7877 Pleasant Grove Rd., Elverta, CA 95626
Parm Randhawa, Ph.D.
tel: 916/ 655-1581; fax: 916/655-1582
e-mail: randhawa@calspl.com
website: www.calspl.com

PLEASE SEE CALIFORNIA SEED & PLANT LAB ADS, PAGES 34, 46.

Weed Badger Division

Weed Badger Division introduces the Model 4200 "Wee" Badger Series. It's a major breakthrough for in-row tillage and mowing in vineyards, since the design is for smaller tractors in the 18 to 30 HP range. The new series puts aggressive weed killing rotary power tillage to work on lighter fuel-efficient tractors while reducing soil compaction.

The Model 4200 series fits very narrow row spacing and is ideal for working in high-density vineyards. When mounted on a 36-inch wide tractor this Weed Badger® can squeeze through row middles as narrow as 47 inches adding as little as 9 inches to the tractor width when retracted. The Model 4200 saves money by replacing hand labor, eliminates dependency on toxic herbicides to burn back weeds, killing the biggest, most common herbicide-resistant weeds.

The exclusive features include a "no-chatter" pump drive system, on-the-go fingertip control tilt, and a rugged, adjustable frame. Interchangeable optional attachments make the Model 4200 a powerful in-row tool carrier. Till, mow, sweep, stir mulch, disk, incorporate soil amendments, hill-up, hill-down, and more.

Ask for free video or DVD. Call 800/437-3392. 24-hour fax number: 701/778-7501; website: www.weedbadger.com; e-mail inquiry@weedbadger.com.

For more information, contact:
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5673 95th Ave. SE, Marion, ND 58466-9718
tel: 800/437-3392; fax: 701/778-7501
e-mail: inquiry@weedbadger.com
website: www.weedbadger.com

PLEASE SEE WEED BADGER DIVISION AD, PAGE 8.

Agro-K Corporation

Agro-K is a leader in phosphite-based fertility technology with Vigor-Cal-Phos (VCP™), a calcium phosphite-based fertilizer proven in university trials to induce disease resistance and enhance plant growth. By promoting vine health and nutrition, by improving phosphorus and calcium uptake, and by stimulating a plant's natural defense mechanisms, VCP™ has proven to growers that it can push grape quality to a new level of excellence.

New for the 2006 growing season, Agro-K introduces a complete line of "nutrient-inducing" phosphite-based fertilizers including zinc, magnesium, manganese, copper, potassium, and various blends specifically suited to needs of winegrapes.

This new line of fertilizers will be truly unique to the industry. In addition, this new phosphite product line is 100% compatible with each other, even calcium and potassium, and will allow growers to mix and match nutrients, as grapevine needs dictate.

For information on how Agro-K can help improve your vines' health and grape quality, contact Agro-K today.

For more information, contact:
Agro-K Corporation
8030 Main St., Minneapolis, MN 55432
tel: 763/780-4116; fax: 763/780-4316
toll free: 800/328-2418
e-mail: info@agro-k.com
website: www.agro-k.com

PLEASE SEE AGRO-K AD, PAGE 56.

Central Valley Builders Supply

"CV has been a partner with the vineyard industry since the beginning" says Kathleen Patterson, president of Central Valley Builders Supply (CV). "We have grown into one of Northern California's largest suppliers of vineyard products and equipment."

The CV Ag Department carries a large assortment of vineyard supplies including trellis, fencing, irrigation, drainage, erosion control, pruning, Macrobins, and much more. Visit the website, www.cvbsupply.com, for a complete list of supplies and links or call one of the two locations.

In an effort to be the complete vineyard supplier for northern California, CV Ag continues to look for ways to service customers. CV Ag looks to expand outside Napa Valley into neighboring areas. CV Ag feels customers need CV Ag to be in more locations and closer to their current projects.

All changes in recent years, and those yet to come, will increase CV Ag's commitment to customer service. New inventory items and services in the St. Helena and Napa, CA facilities are continually added. With an American Canyon distribution facility and a fleet of delivery trucks, CV Ag has the quantity of material customers need with the ability to deliver the product to customers when they need it the most.

For more information contact:
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1100 Vintage Ave., St. Helena, CA 94574
tel: 707/967-4300; fax: 707/963-8952
1790 Soscol Ave., Napa, CA 94559
tel: 707/257-8888; fax: 707/261-2962

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Ray Carlson & Associates

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Surveying — Did you know that a current survey might help you increase the value of your property?

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GPS — Ray Carlson & Associates uses the latest technology, but believes that high-tech will never replace high-touch.

Ray Carlson & Associates combines a variety of high-quality products with dedication to customers and their needs, and have been surveying and mapping land in Sonoma county and surrounding California counties since 1976.

For more information, contact:

Ray Carlson & Associates
411 Russell Ave., Santa Rosa, CA 95403
tel: 707/528-7649; fax: 707/571-5541
website: www.rcmaps.com

PLEASE SEE RAY CARLSON & ASSOCIATES AD, PAGE 56.

OXBO International Corp.

GreenTech

OXBO offers the GreenTech Spray System for growers looking for effective, quality coverage in their spraying operation.

GreenTech sprayers utilize unique, high-volume, electrically-driven prop-style fan heads to deliver a high volume of air to provide maximum coverage. Each head contains eight adjustable nozzles with angled heads to minimize chemical waste and maximize control over your spraying operation. With electrically-driven fan heads, there is no risk of oil contamination from the sprayer.

OXBO offers a number of different GreenTech models, including tow-behinds with 110-, 230-, and 530-gallon capacity. Each sprayer can be customized to fit your needs and applications. OXBO also offers the GreenTech three-row model for various multi-function harvesters, including the Korvan 4012.

Other benefits of GreenTech sprayers include high-speed application, the ability to spray effectively in windy conditions, and a well-built, rugged sprayer chassis. All GreenTech sprayers are backed by OXBO's service and parts network.

The complete line of GreenTech sprayers is part of OXBO's Vineyard Solutions line, providing growers with year-round solutions for the vineyard.

For more information, contact:

OXBO International Corp.
Vineyard Products
14344 S. Betherl, Kingsburg, CA 93631
tel: 559/897-7012
CA reps: **Mitch**: 559/285-5804
or **Rolf**: 360/815-1556
e-mail: korvan@korvan.com
website: www.korvan.com or
www.oxbocorp.com

PLEASE SEE OXBO INTERNATIONAL AD, PAGE 49.

Spec Trellising

Spec Trellising is a family-owned and operated trellis supply company whose goal is to develop and maintain long-term relationships with customers. Spec works closely with customers and meets their needs with high-quality trellis materials and trellis-related products at reasonable cost and first-rate service.

Spec recommends only top-quality, long-lasting trellising materials be used for grapevine trellising. While lower-quality products can undoubtedly be found, it is Spec's sincere belief that grapevine trellising is not the place to cut corners. Trellis construction is a laborious, costly task that should be done right the first time, using only the finest products. Research indicates that good, sound canopy management is critical to formation of high-quality fruit and begins with proper materials.

Spec's diversified product line includes everything grapegrowers need to trellis and train vines, and to manage canopies. The company's products are among the best of their kind in the world and include steel posts, hi-tensile wire, vine shelters, bird netting, vine-tying products, and more.

Developing long-term relationships with grapegrowers is Spec Trellising's goal and the staff works hard to accomplish this.

For more information, contact:

Spec Trellising
39 Indian Dr., Ivyland, PA 18974
tel: 800/237-4594 or 215/322-5588
fax: 215/357-3122
e-mail: info@spectrellising.com
website: www.spectrellising.com

PLEASE SEE SPEC TRELLISING AD, PAGE 46.

Soil Culture™ Consulting

Soil Culture Consulting provides experienced, dedicated consulting for winegrowers to develop and implement holistic and biologically-integrated cultural practices that improve soil and vine health, and fruit quality.

Bob Shaffer, soil scientist and viticulturist for Soil Culture Consulting, has 16 years experience working with vineyards ranging in size from 1 to 4,000 acres growing many varieties in a wide range of terroir. Bob has 33 years experience with organic farming systems, is a nationally-recognized consultant, educator, and farmer working in temperate and sub-tropical farming ecosystems.

Since 1990, Soil Culture Consulting has grown to be one of northern California's most experienced and dedicated consulting resources for scientific organic viticulture and a leading provider of time-tested, expert advice which has preserved ecosystems, improved soil health, elevated vine disease resistance, and helped to produce award-winning wines.

Shaffer has an excellent reputation for reliable, clear, plain-language recommendations based on comprehensive site investigations and experienced interpretation of complex biological, chemical, and physical aspects of vines and soil ecosystems.

Partial list of clients includes:
Bonny Doon Vineyards
Chateau Montelena Winery
Cal Plans Vineyards
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Duckhorn Winery
Enterprise Vineyard Management
Hambrecht Vineyards
Hess Collection Winery
King Estate Winery
Pina Vineyard Management
Rubissow Sargent Winery
Simi Winery
Wente Winery

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Sherry Lutz, office manager
tel: 707/938-8665; fax: 707/938-8667
e-mail: SoilCulture@aol.com

Agajanian Vineyards

Agajanian Vineyards Winegrape Brokerage provides a variety of services to satisfy its customers' varied needs.

Winery Services: Winegrape Procurement: Let Agajanian Vineyards assist you in finding exceptional values on winegrapes throughout California on a brokerage or a full-service basis and help assure you get the grapes to fulfill your market demand.

Winegrape Inspections: Save valuable time during harvest and let Agajanian Vineyards provide on-site field inspections. Only through inspection will you assure that your quality needs are met on existing contracts and on any new grapes that you may purchase. Most importantly, the sole focus is to help you enhance your wine quality, and control your costs.

Growers Services: Grapes for Sale Listing: Available wine grapes are listed and, once contacted by winery clients, the Agajanian Vineyards data base will be accessed for a match (no charge).

Grape Marketing: If you want to find the best possible market for your wine grapes, list your grapes as above, and Agajanian Vineyards will actively market your grapes by (no commission charge until grapes are sold):

- Presenting your grapes in a professional manner to wineries throughout North America;
- Promoting your grapes through advertising, fax and email campaigns, direct mail, telephone, and personal meetings;
- Saving you time in finding qualified buyers,
- Giving you market feedback;
- Assisting you in long-term planning.

For more information, please contact:
Agajanian Vineyards
North Coast: Chris Lindelof
tel: 707/894-1828; cell: 707/696-7164
California: Gary Agajanian
4582 W. Jacquelyn Ave., Fresno, CA 93722
tel: 559/271-2426; fax: 559/271-2094
cell: 559/351-9354
e-mail: gary@agajanian.com
website: www.agajanian.com

PLEASE SEE AGAJANIAN VINEYARDS AD, PAGE 56.

Orchard Valley Supply, Inc.

For 20 years, Orchard Valley Supply has been a wholesale provider of high quality products and services for everything between the vine/plant and the fruit/wine.

Orchard Valley Supply carries everything related to trellis, training, pruning, harvest, wildlife control, irrigation, and winemaking supplies. Orchard Valley Supply distributes quality products such as: Gripple, Clip-It System, Rebiga Ties, The Grapefork, and The Wire Care Clip. Orchard Valley has everything you need to build your trellis system, train your vines, and harvest the fruit.

Orchard Valley SUPPLY.COM

Orchard Valley Supply sells all the major brands including Felco, Corona, Prothec System, AgFast products, Treessential products, Fenox products, Solo, Gripple, Tyvek safety clothing, Kasco helmets, Wirevise, and Wirelink.

If you need an item that you cannot find on their website or in their catalog, contact Orchard Valley Supply and they will try to find it and carry it going forward. Discounts are provided to first-time customers and volume orders. Order online at www.orchardvalleysupply.com, or by calling toll free: 888/755-0098! Orchard Valley Supply ships coast to coast!

Remember, No Vines, No Wines, Just Everything in Between!

For more information, contact:
Orchard Valley Supply, Inc.
tel: 888/755-0098; fax: 704/455-4952
e-mail: info@orchardvalleysupply.com
website: www.orchardvalleysupply.com

Orchard-Rite®

Orchard-Rite® wind machines are among the industry's most dependable protection against the damaging effects of spring frosts and winter freezes. Wind machines work with nature to pull warmer air down into vineyards to raise temperatures and save vines and grapes.

Orchard-Rite® wind machine dependability starts with selection of top-quality raw materials. Materials are then fabricated, assembled, or precision-machined under a strict quality control program.

Orchard-Rite® wind machine blades are an industry standard for safety and efficiency, using a unique design and proprietary process to construct durable, all-fiberglass blades.

There are six wind machine models, with a horsepower range of 60 to 170 with a variety of options for powering the machines including gasoline (petrol), liquid propane gas, natural gas, vapor propane gas, diesel, electrical power plants, and PTO.

All Orchard-Rite® wind machine gearboxes use a fail-safe oil submersion system for added reliability and longevity.

Each Orchard-Rite® wind machine is designed to be site-specific. Using tools such as detailed aerial photographs and GPS technology, Orchard-Rite studies the topography of the land before recommending a possible site for a new wind machine. A sales representative experienced in wind machine placement reviews every site before installation, working closely with the grower to find the optimal location and options to maximize the wind machine's performance.

For more information, contact:
Orchard-Rite®
PO Box 9308, Yakima, WA 98909
tel: 509/457-9196 ext. 140
e-mail: sales@orchard-rite.com
website: www.orchard-rite.com

PLEASE SEE ORCHARD-RITE AD, PAGE 33.

Actagro Plant Nutrients

Actagro is a manufacturer/marketer of organic acid-based plant nutrients. Organic acids used in production of Actagro products are very similar to what occurs in nature as stable soil humus. Actagro's success comes from working with, and imitating, nature in both form and source. Actagro plant nutrients are extremely efficient, highly plant-responsive, and environment-friendly.

Actagro reacts specific organic acids with plant nutrients in a process called "organic complexing." Organic complexing prevents nutrients from being tied up in the soil, maintains them in a readily absorbable form, and protects plants from the phototoxic salt effects of inorganic materials. Actagro's organic complexing is not a simple blending operation. Actagro products are produced through carefully controlled and patented manufacturing processes.

Actagro product use in California winegrape production has increased dramatically in the past few years. STRUCTURE® is a unique phosphate/organic acid-based product used to strengthen root systems, promote balance vine growth and increase berry quality. In combination with Actagro's 4.5% Iron and 6.5% Zinc, STRUCTURE can reduce lime-induced chlorosis. Organic complexing vastly improves phosphate availability in the soil and allows application through drip irrigation systems without danger of plugging emitters.

Actagro not only offers high-quality plant nutrients but also experienced and knowledgeable staff that take pride in helping growers solve vine nutrient problems and providing sound agronomic advice.

For more information, contact:
Actagro Plant Nutrients
PO Box 309, Biola, CA 93606
tel: 559/843-2700
website: www.actagro.com

PLEASE SEE ACTAGRO AD, PAGE 30.

Sunridge Nurseries, Inc.

Sunridge Nurseries Inc., a full-service nursery, has been providing top-quality grape nursery stock to the wine and table grape industries for over 25 years. Many different varieties and clones grafted on your choice of rootstock are available and all material is hot water-dipped to ensure pest-free, high-quality vines.

Sunridge is an official ENTAV licensee. New introductions include: Cabernet Sauvignon 412 and 685, Pinot Noir 943, and Sauvignon Blanc 297. Horticultural experts are on staff and available to service your vineyard, on-site.

Where the vintage begins
The quality leader for more than 25 years

Sunridge Nurseries has a plant protector that is an affordable way to protect young vines from herbicide sprays, small animal feeding, and wind damage. When planting dormant vines, the top of the plant protector can be closed to simulate a greenhouse environment that enables vines to push buds without drying out. Once the root takes hold and the vine buds push, the plant protector can be opened or unsealed quickly (no shovel needed) and simulates a common grow tube. Costly expenses due to mounding are avoided.

Contact Sunridge Nurseries today to satisfy all vineyard planting needs.

For more information, contact:
Sunridge Nurseries, Inc.
Brian Crettol, Sales Coordinator
441 Vineland Rd., Bakersfield, CA 93307
tel: 661/363-VINE (8463); fax: 661/366-4251
e-mail: bcrettol@sunridgenurseries.com
website: www.sunridgenurseries.com

PLEASE SEE SUNRIDGE NURSERIES AD, PAGE 55.

A&P Ag Structures, Inc.

For 30 years, A&P Ag Structures has assisted wine grapegrowers in producing the best quality, high-yield crops at the most reasonable cost. The secret to A&P's longevity is a willingness to work with growers to design the best trellis structure for the grape variety being grown, and then to use the best materials and crew supervision for installation.

A&P offers a wide range of vineyard products designed to boost production and increase efficiency including wood and steel posts, screw anchors, bamboo, grow cartons, wire, many types of clips, wire tighteners, cowboy fasteners, crimp sleeves, and more.

Every A&P product is manufactured from the finest materials. A&P rail steel stakes and wood posts are lab-tested and certified that they meet industry standards for strength and durability. A&P vineyard wire has been custom-developed to provide optimum strength and longevity.

A&P employs a full-time draftsman who draws field maps to scale so that A&P sales representatives can produce accurate job proposals. A&P crew supervisors are highly trained with many years of experience in all phases of vineyard installation. Over 30 years, A&P has developed and built the heavy equipment necessary to efficiently install all types of systems, over all kinds of terrain, and under all conditions.

For more information, contact:
A&P Ag Structures, Inc.
11266 Ave. 264, Visalia, CA 93277
tel: 559/685-8700 or 559/685-8622
toll free: 877/780-6985
e-mail: aandpag@grapesystem.com
website: www.aandpag.com

PLEASE SEE A&P AG STRUCTURES AD, PAGE 39.

Cold Creek Compost, Inc.

What is so special about Cold Creek Compost (CCC), and why should you use it?

CCC is the first permitted composting facility in the north coast of California. CCC led the way by producing and selling compost long before California's recycling mandate that spawned many green waste compost facilities. The facility has undergone more extensive review, and is held to the highest standards by regulatory agencies above any other facility in the region.

CCC has become known for producing only the best product. Unlike many other facilities, which were primarily developed to divert garbage from landfills, CCC's primary purpose has always been to provide growers with a less expensive and better alternative to traditional fertilizers.

Cold Creek Compost, Inc.

CCC focuses on its product; the company's success is a good indication of the outstanding value of its product to customers. Since 1984, CCC has been supplying north coast growers with lime, gypsum, compost, and custom blends. Growers focused on lowering production costs and reducing the environmental impact of farming operations should seriously evaluate what CCC offers.

Imagine the effect on your bottom line when you reduce fertilizer, pesticide, irrigation, and tillage costs while gaining the benefit of a premium for an "organic" crop!

For more information, contact:
Cold Creek Compost, Inc.
6000 Potter Valley Rd., Ukiah CA 95482
PO Box 818, Redwood Valley, CA 95470
tel: 707/485-5966
website: coldcreek@saber.net

Duarte Nursery, Inc.

Choose Duarte Nursery Big Pot Benchgrafts for your vineyard; measure the quality by their performance. Duarte offers Big Pot Benchgrafts with a guaranteed stand and free delivery in most of California and Oregon.

Duarte offers one of California's best vineyard service teams. A Duarte viticultural consultant is available to provide sales and service throughout California and Oregon grapegrowing regions.

DUARTE TREES & VINES

With the use of Big Pot Benchgrafts and consultation from Duarte's vineyard service team, you're guaranteed a successful planting.

Duarte defines quality as your complete satisfaction. Please call today.

For more information, contact:
Duarte Nursery, Inc.
1555 Baldwin Rd., Hughson, CA 95326
tel: 209/531-0351; fax: 209/531-0352
e-mail: sales@duartenursery.com
website: www.duartenursery.com

PLEASE SEE DUARTE NURSERY AD, PAGE 87.

EURO-MACHINES, INC.

Euro-Machines introduced the BRAUD VL Grape Harvester in 2004. In 2006, the Braud VX series harvester has all the improvements and innovations introduced through the VL series, and the VX is larger, has more HP, and a wide 32-inch throat.

State-of-the-art technology provides top quality harvesting and full multi-function capability. The cab is sealed and pressurized for noise reduction and spray safety. A multi-function lever controls all harvester functions with preset picking programs and all multi-function attachments. Hydrostatic transmission with cruise control is standard.

The harvester head has a patented quick-shaker rod engagement; this enables activation of more or less shaker rods as the fruit zone requires. Varying leaf volumes of the vine, picking conditions, and grape varieties are easily handled by the operator viewing the picking process on a color monitor.

Adjustments are just a fingertip away on the multi-function lever. Four highly efficient cleaning fans eliminate leaves. For optimal cleaning efficiency, an optional patented destemmer makes it possible to destem and eliminate any MOG. The result is the cleanest fruit delivered to a winery by machine harvesting.

A large inventory of used, reconditioned, and lease-return machines is available.

For more information, contact:
Euro-Machines, Inc.
Eastern U.S.: 540/825-5700
Western U.S.: 4950 E. Fulton Dr.
Cordelia, CA 94534
tel: 707/864-5800; fax: 707/864-5879
e-mail: mattateuro@aol.com
website: www.euromachinesusa.com

PLEASE SEE EURO-MACHINES AD, PAGE 51.

Create Electricity with your unproductive land!
Premier Power can help you take advantage of that land and reduce or eliminate your electric bill!

Premier Power
"Your Solar Electricity Specialists"

-Solar Landscaping will take that unusable space on your property and turn it into a Solar power plant of your very own.

-Create electricity with your unproductive land! Parking structures, tractor ports, side of hills or slopes, pump houses, ponds, nursery shades, dairy shades.

-Take advantage of the new limited 30% Federal tax credit and state rebates that will pay for up to 60% of the cost of your solar electric system!

Request a free information packet

Visit us online at www.premierpower.com or call 877.939.0400

A Little Piece of the World as We Know it...

Our Northern California wine industry is a world unto itself with a language, culture and set of finite resources. With over 27 years of serving the wine industry, this world is as much a part of Summit Engineering as our dedication to every project.

Even if our part of your project is a small one, our structural, civil, water/wastewater or electrical engineers consider the whole picture. At Summit, we will support your team as though it meant the world to us.

Because, it does.

Your project, Our world.

707.527.0775
www.summit-sr.com

SUMMIT

Durand-Wayland, Inc.

Durand-Wayland, Inc is a leading manufacturer of PTO sprayers for vineyards. From economical three-point hitch models to a new SilverLiner R32/400 model, Durand-Wayland's sprayers are designed to deliver optimum protection for grapes. The model 3P50-24 features a three-position, 24-inch axial-flow fan, 50-gallon polyethylene tank, and 10.5 gpm diaphragm pump. The model 3P100-32 has a three-position, 32-inch axial-flow fan, 100-gallon polyethylene tank, and an 18.9 gpm diaphragm pump. Both are ideal for small operations.

The SilverLiner R32/400 has a 400-gallon stainless steel tank and is perfect for large, mature vineyards. A unique "reverse fan" design increases the area of the air-intake four-fold, and helps eliminate accumulation of leaves and debris at the rear intake guard. The SilverLiner R32/400 is also equipped with a patented "SureTrac" tracking hitch to help keep the sprayer and tractor in alignment, allowing for tighter turns under full power. Options for the SilverLiner R32/400 include: vineyard towers, lower air scoops, electric valves, and gun-outlet kits.

Options for three-point hitch models include: Stainless steel top and bottom "V" air deflectors, one-way stainless steel volutes with nozzle kits, cable control discharge for one-way volute, two-way stainless steel volutes with nozzle kits, and ceramic nozzle conversion kits.

For more information contact:
Durand-Wayland, Inc.
Rick Cordero
PO Box 1404, LaGrange, GA 30241
tel: 800/241-2308 or 706/882-8162
fax: 706/884-3268
e-mail: sales@durand-wayland.com
website: www.durand-wayland.com

PLEASE SEE DURAND-WAYLAND AD, PAGE 19.

STA Laboratories, Inc.

STA Laboratories provides disease detection and eradication services specifically for grapevines. STA's reliable and rapid plant health testing services enable grape growers, nursery managers, and wineries to obtain the highest yield possible while producing desired grape quality. Testing services have been designed to go above and beyond existing state certifications because optimal plant health does not originate or end in a lab.

To help achieve grapevine health, the following services are offered:

Disease Detection — Early detection helps growers avoid costly plantings and spread of disease to new vineyards. STA HealthCheck™ detects known grapevine pathogens using traditional and modern serological or molecular diagnostic technology, such as microbial plating, ELISA, real-time PCR, and traditional PCR.

Disease Eradication — STA offers custom disease eradication services that use modern technology to completely eliminate diseases from stock plant material.

Plant Health Consultation — STA works closely with you in the field to discuss your specific testing needs, recommend sampling strategies to more accurately detect the presence of pathogens in spite of low concentration or erratic distribution in the vine, and provide field or nursery operation inspections to assess grapevine health.

For more information, contact:
STA Laboratories, Inc.
Judit Monis, Ph.D.
5653 Monterey Frontage Rd.
Gilroy, CA 95020
tel: 408/846-9964; fax: 408/846-9954
e-mail: judit.monis@stalabs.com
website: www.stalabs.com

Terra Spāse, Inc.

Terra Spāse, in partnership with John Deere, has launched a new approach to gather and apply soil data to vineyard production and quality-related issues. The Soil Information System™ (SIS) is being used in vineyard site analysis, terroir mapping, design and development planning, vine nutrition and irrigation scheduling, and vineyard problem resolution.

The SIS system combines patented, state-of-the-art soil physical data collection technology (texture, compaction, water holding capacity) with chemical analysis to create the most detailed and accurate maps of soil variability commercially available. Products include soil maps that can be used to support vineyard layout, drainage and irrigation system design, variety and rootstock selection, soil preparation (ripping depth), and pre-plant soil amendment and fertilizer applications.

Soil Vigor Potential Plus™ and plant available-water maps are being used in existing vineyards for trouble shooting of stressed areas or under-performing sections, and for directing canopy management, fruit thinning, and selective harvest decisions. SIS data can also help optimize sensor placement and improve vineyard efficiencies for labor, water usage, and data collection.

Other Terra Spāse information products include near real-time, North Coast weather data, vineyard-specific measurements of vine water status, soil moisture status, and NDVI maps of vine canopy density. Weather and disease risk maps for Napa and Sonoma counties and Fox Weather products are available online at www.terraspase.com.

For more information, contact:
Terra Spāse, Inc.
345 La Fata St., Ste. D, St. Helena, CA 94574
tel: 707/967-8325; fax: 707/967-8596
e-mail: terraspase@earthlink.net
website: www.terraspase.com

PLEASE SEE TERRA SPASE AD, PAGE 53.

Biologically Integrated Organics®, Inc.

Biologically Integrated Organics®, Inc. (**bio**) is a leader in providing natural biological solutions for agriculture. **bio** personnel understand the importance of healthy soil and believe there is no chemical replacement for what a diverse population of microorganisms and their complex, biological processes impart to the soil.

Plant and microbial communities share a symbiotic relationship, exchanging the benefits of protein, nitrogen, and oxygen. The majority of microbes in the soil are beneficial to plant health, and maintaining a proper balance in microbial diversity and numbers can promote aerobic activity in the soil. This both aids in the assimilation of nutrients and drives development of a vigorous root-system.

bio's VESTA® has shown outstanding results in helping counter stressed growing conditions. In a trial with Dr. Kendra Baumgartner (UC Davis) on Armillaria root disease (oak root fungus), results showed increased yields and cluster weights on infected vines. She concluded that VESTA appears to be a promising approach for control of Armillaria root disease when treated early.

CARBEA®, was developed for soils with low organic matter. Its high levels of humic and fulvic acids provide a food source immediately available to microorganisms. Combinations of CARBEA and LiquiComp®, or CERES and LiquiComp work together through biological processes to augment and stimulate the soil's microbial community. All products are rich with a broad spectrum of microbes and their metabolites to create diverse, stable microbial populations, leading to healthier, more productive vines.

For more information, contact:
Biologically Integrated Organics®, Inc.
1720 Moon Mountain Dr.
Sonoma, CA 95476
tel: 707/939-8090; fax: 707/939-8092
e-mail: rmcneill@bio-inc.com
website: www.bio-inc.com

Vineyard Industry Products, Co.

Vineyard Industry Products Company (VIP) has provided trellis systems and supplies to California grape growers for two generations. VIP has knowledgeable sales staff, competitive prices, and exceptional customer service. Carrying one of the largest available inventories in the industry, VIP offers both will call and direct vineyard shipment.

VIP carries everything associated with the vineyard trellis: highway posts, T-Posts, rebar and pencil rod training stakes, crossarms, lodgepoles, steel end posts, double welded screw in earth anchors, class 1 galvanized high tensile wire, clips to fit all stakes, Gripple brand wire connectors and tighteners. Many sizes and types of fencing materials, Jump Start™ grow tubes, Bare Hand™ brand bird netting, pruning and tying supplies, and more.

VIP offers the patented (Pat. #5501035 and #5916028) J~R Clip™. Designed to fit all size T-posts for vertical trellis systems, this versatile clip is installed in seconds and withstands mechanical harvesting and pruning.

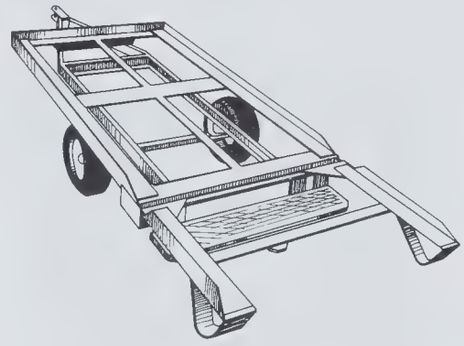
To protect your investment and help insure a successful harvest, VIP offers superior bird protection: Bare Hand Bird Nets™. Bare Hand™ is the most cost-effective and comprehensive protection available. Fast to install, fast to remove, the ultimate in full protection.

For more information contact:
Vineyard Industry Products, Co.
North Coast
10603 Old Redwood Hwy.
Windsor, CA 95492
tel: 707/431-1356 or 800/544-2210
fax: 707/431-0807
Central Coast
10B Volpi Ysabel Rd., Paso Robles, CA 93446
tel: 805/226-9960 or 800/491-9833
fax: 808/226-9818
e-mail: info@vineyardindustryproducts.com
website: vineyardindustryproducts.com

PLEASE SEE VINEYARD INDUSTRY AD, PAGE 37.

Western Square Industries

Western Square Industries manufactures vineyard bins, trailers, and wine barrel racks.



Western Square's two-ton vineyard bins are manufactured in stainless or mild 14-gauge steel. The sides, endwalls, and bottoms are lap-welded to ensure strength and watertight integrity. The D-ring end is ribbed to transfer the stress of hoisting to the entire height of the bin end. Mild steel bins are powder-coated in a variety of colors with an FDA-approved, food-grade epoxy inside. These and other features ensure years of trouble-free use.

Western Square vineyard trailers are offered in six styles designed for narrow or wide vineyard rows. Trailer configurations accommodate two-ton harvest bins or up to three 4-by-4 plastic bins. Several styles are outfitted with ramps and plastic slides to drop bins without needing a forklift, facilitating a speedy return to the harvest. A new tilt trailer design eliminates the need for a hydraulic lifting mechanism. Simplicity of design and a durable powder coat finish contribute to easy maintenance. Add a 4-by-8 sheet of plywood and the trailer becomes a utility trailer for off-season projects.

All Western Square products are manufactured in America.

For more information, contact:
Western Square Industries
Trygve Mikkelsen
1621 N. Broadway, Stockton, CA 95205
tel: 209/944-0921; toll free: 800/367-8383
website: www.westernsquare.com

PLEASE SEE WESTERN SQUARE AD, PAGE 11.

Turf-Seed, Inc.

The pictures below show the benefits of Aurora Gold hard fescue in vineyard management.

Tractor rows shown are adjacent to each other and depict better water absorption, elimination of erosion, and a working surface that eliminates mud in the winter and dust in the summer.

Aurora Gold hard fescue can be sprayed with 16 ounces at 41% glyphosate without damage and provides very economical weed control.

For more information, contact:
Turf-Seed, Inc.
Tom Stanley
1741 Santa Ynez St., Ventura, CA 93001
tel: 805/641-9911; fax: 805/641-9912
e-mail: tom@turf-seed.com
website: www.turf-seed.com

SureHarvest, Inc.

As competitive pressures across the wine industry intensify, vineyards must optimize fruit quality and yield while controlling costs. The value of timely, site-specific, and easily accessible vineyard information to enhance management decisions continues to increase. The ability to document and communicate sustainable winegrowing practices is an emerging competitive advantage.

SureHarvest
SUSTAINABILITY SOLUTIONS

SureHarvest empowers customers with information they need to optimize quality and yield, benchmark best practices, and increase efficiency. SureHarvest offers an integrated vineyard information management software package with professional and responsive IT services.

Implement the enterprise system or individual modules including canopy management; chemical and fertilizer applications; contracts; cover cropping; GIS; harvest; irrigation; mowing and cultivation; weather; planting and grafting; and sampling of growth and development, pests, petioles, soils, quality metrics, and yield estimates.

By working in partnership with CAWG, Wine Institute, CSWA, and many regional associations on the Sustainable Winegrowing Practices program, SureHarvest is uniquely positioned to offer products and services that integrate best practices with crop-specific software. SureHarvest software solutions are used on more than 30,000 acres of California premium winegrapes, by CSWA to benchmark sustainable winegrowing practices, and on more than 40,000 acres of potatoes and vegetables throughout the U.S.

For more information, contact:
SureHarvest, Inc.
2901 Park Ave., Ste. A2, Soquel, CA 95076
tel: 831/477-7797; fax: 831/477-7790
e-mail: sales@sureharvest.com, or
pmitchell@sureharvest.com
website: www.sureharvest.com

Sierra Gold Nurseries

A recent revolution has occurred in the olive oil industry with introduction of a super-high density planting system that allows for over-the-row mechanical grape harvesters to efficiently harvest olives for olive oil with minimal labor.

SG
Sierra Gold Nurseries

Sierra Gold Nurseries sells the top three super-high density varieties, Arbequina Clone i-18®, Arbosana Clone i-43®, and Koroneiki Clone i-38®. These unique olive tree clones have a compact growth habit ideal for super-high density cultural practices and are renowned for premium extra-virgin olive oil. These varietals are early producing with an initial harvest two years after planting. With super-high density tree spacing, more trees per acre equal greater yields of four to six tons per acre on mature blocks with olive oil yields of 40 gallons per ton.

Since 1951, Sierra Gold Nurseries has supplied top quality trees to orchardists and is excited to be supplying super-high density olive trees to growers in California.

For more information, contact:
Sierra Gold Nurseries
5320 Garden Hwy., Yuba City, CA 95991
tel: 800/243-4653
website: www.sierragoldtrees.com

PLEASE SEE SIERRA GOLD NURSERIES AD, PAGE 15.

Mercier Grapevines

A new nursery located in Vacaville (CA) is the subsidiary of "Pépinières Mercier," the largest French grapevine nursery. The Mercier Group is well-known in leading vineyard regions for reliability, perseverance, dynamism, and flexibility.

ENTAV-INRA® licensed, Mercier Grapevines propagate French clones and California certified material in order to provide high-quality vines: dormant and green benchgrafts, and rootings.

The dedication of the men and women in the Mercier Group to vine growing and innovation has made the group a leading producer of vines.

The Mercier Group has a suitable, high-quality solution to all your vineyard management and winemaking needs.

A list of grape varieties and rootstocks is available upon request.

For more information, contact:
Mercier Grapevines
Guillaume Mercier
6760 Pleasant Valley Rd.
Vacaville, CA 95688
tel: 707/689-6789; fax: 707/446-9223
e-mail: guillaume.mercier@mercier-groupe.com

McLean Automation

Australian OEM (original equipment manufacturer) McLean Automation acknowledged the well-worn local expression "Have a go," and is trying their luck in the North American market. The company specializes in low-power radio license-exempt wireless monitoring and control systems for agricultural applications in the 1 to 3-mile range. A 20-year veteran in the South Pacific market, the Sydney-based operation is offering their range of cableless frost alarms and radio-controlled irrigation systems in the U.S. this year.

Company founder Kris McLean is hoping that the favorable exchange rate and a new free trade agreement will make their simple systems an affordable alternative for U.S. growers. Adapted to harsh Australian "outback" conditions, the product line is listed on the company website, www.ma1.net.au.

McLean Automation solar-powered valve control station, one of 50 in a radio-controlled irrigation system run from a desktop PC.

For more information, contact:
McLean Automation
518 Terrace Rd., Freemans Reach
NSW, 2756 Australia
tel: 612 45796365; fax: 612 45796942
website: www.ma1.net.au

PGT, Inc.

On-Target Charged Spray Systems

On-Target offers electrically-charged sprayers for growers in the vineyard, orchard, row-crop, and nursery industries. For over a decade, PGT has improved the sprayers and expanded to include the western U.S., Australia, and South America.

On-Target sprayers produce billions of electrically-charged spray drops per minute. All charged-drops are attracted to a plant, resulting in unequaled coverage and uniformity and radically reducing drift and run-off which are the most wasteful and costly processes in any spray program.

On-Target sprayers are designed and fabricated in California. The stainless steel construction is compact and of the highest quality. With this design comes flexibility; unlimited adjustment capabilities for single or double row, running parallel with any trellis system for uniform coverage. Growers have found reduced application time, pesticide quantity, and risk to employees a great advantage over traditional spraying methods.

The On-Target system has proved itself to be efficient and reliable, spraying more acres in a day than any other sprayer.

For more information, contact:
PGT, Inc.
On-Target Spray Systems
California representative: **Gary Soares**
tel: 831/595-9433
31421 SW Olympic Dr.
Wilsonville, OR 97070
tel: 503/329-8120
e-mail: info@ontargetspray.com
website: www.ontargetspray.com

PLEASE SEE ON-TARGET SPRAY SYSTEMS AD, PAGE 31.

Equipment That Works!

The Vineyard Auger is designed to mount on the side of a tractor and be operated from the tractor seat. It operates on eight gallons of hydraulic fluid per minute yielding 350 lb/ft of torque at 2,000 psi and drills a nine-inch diameter hole 12 inches deep.

The unit is available in two boom lengths. The short boom is 32 inches long with an extension of 12 inches and a total reach of 44 inches. The longer boom has a 40-inch stowed length with an extension of 18 inches for a total reach of 58 inches. Choose the length to match your vine row and tractor width.

Vineyard Augers are in use from Oregon to Georgia, California to New York. They can be operated from almost any tractor with adequate hydraulic flow. One user has it mounted on a crawler tractor in the center of the blade-mount on a pivot so that the unit can work on either side of the tractor.

The standard package includes a nine-inch diameter, 12-inch long auger mounted on a boom that will stow within the track of the tractor. The package also includes a three-section control valve that mounts on the floorboards of your tractor or on a platform extension if the tractor is too narrow for both operator and valve control. Up to 250 holes per hour have been reported. Literature is available upon request.

For more information, contact:
Equipment That Works!
tel: 800/880-8190; fax: 913/371-0123

PLEASE SEE EQUIPMENT THAT WORKS! AD, PAGE 18.

Spectrum Technologies, Inc.

Spectrum Technologies has been a leader in weather-monitoring, irrigation, nutrient-management, and IPM technology since 1987. Years of hands-on farming and agricultural experience coupled with technical know-how makes Spectrum a great resource to help grow consistent, high-quality grapes at low cost.

Spectrum Technologies, Inc.

WatchDog Frost Alert — Growers can spot frost from miles away. When the temperature approaches freezing, a high-powered LED light changes color and flash frequency to indicate temperature conditions.

WatchDog Weather Stations/Dataloggers — Growers can adjust irrigation, nutrient, and pest-management methods to fit actual conditions and growing trends in their vineyard with Spectrum's WatchDog easy-to-use, battery-powered weather monitoring systems. Fifteen station and logger choices, and countless sensor arrays allow users to choose the system that best fits their needs and budget.

WeatherTracker degree-day recorders — WeatherTracker systems are perfect options for growers who need a basic, portable weather-monitoring tool. WeatherTrackers record user-specified degree-days, chill hours, and daily and monthly temperature data. Models to record specific conditions (soil moisture, rainfall, etc.) and powdery mildew forecast are available.

Grape Alert disease models — University-validated models to forecast powdery mildew, black rot, and hundreds of insects are available for most WatchDog systems. Avoid costly sprays with powerful grape disease data!

For more information, contact:
Spectrum Technologies, Inc.
12360 S. Industrial Dr. East
Plainfield, IL 60585
tel: 800/248-8873 or 815/436-4440
fax: 815/436-4460
e-mail: info@specmeters.com
website: www.specmeters.com

PLEASE SEE SPECTRUM TECHNOLOGIES AD, PAGE 31.

Mid Valley Agricultural Services, Inc.

Mid Valley Agricultural Services opened in January 1983 to provide a full range of products and services to customers in the northern San Joaquin Valley of California. The founders brought a long and varied list of experience to growers in the Linden area. After five years, a second store was opened in Escalon, followed by Livingston and Patterson in 2000, Hughson in 2002, and Brentwood in 2003.

From that first day, the goal of the company was to provide the best products at a fair value combined with superior technical services. The desired result was, and still is, a sustainable agricultural environment that will serve growers today and for generations to come.

Enjoy the feeling you get when you have the team of Mid Valley Ag professionals working for you. It begins with pre-plant services and continues through the successful harvest of your crops. Mid Valley Ag's pest control advisors and technical staff recommend and use the best products for the enhancement and protection of your land's resources.

Mid Valley Ag represents a wide variety of leading manufacturers that provide solutions from fungicides, insecticides, and herbicides to the latest green biotechnology.

Additional information on Mid Valley Ag services and products can be found on the website: www.mid valleyag.com.

For more information, contact:
Mid Valley Agricultural Services, Inc.
Steve Dugo, Branch Manager
PO Box 593, Linden, CA 95236
tel: 209/931-7618; fax: 209/931-0747

Ranch Systems, LLC

Whether you're looking for better yield and quality or a real-time view of your operations, Ranch Systems is a logical choice for vineyards worldwide.

In 2006, Ranch Systems introduces RanchMaster, the latest innovation in precision agriculture and vineyard automation.

RanchMaster combines cost-effective wireless information collection with powerful Internet software for hassle-free monitoring, insight, and remote control at an affordable price. Comprised of wireless data logger nodes, cellular or WiFi-connected base stations, and a hosted enterprise-level database and software service, RanchMaster provides an unprecedented opportunity for highly-informed management.

Ranch Systems LLC

Measure · Control · Grow

Gather critical information about soil moisture, humidity, temperature, tank levels, and water flow with plug-and-go equipment that works with a range of sensors. Control irrigation remotely via Internet or cell phone, or ensure prompt automatic control when it's needed most by setting up customized rules and triggers.

Improve vineyard performance while reducing costs with sophisticated analysis-functionality that reveals complex trends and interrelationships through straightforward charts and graphs. Even include your own custom data inputs for added insight. With zero-programming, 24x7 system support, and the Ranch Systems satisfaction guarantee, RanchMaster couldn't be easier to use and maintain.

RanchMaster is used in a range of applications, including:

1. Vineyard Monitoring
2. Precision Agriculture
3. Remote Irrigation
4. Tank Management

For more information, contact:

Ranch Systems, LLC
555 De Haro St., #340
San Francisco, CA 94107
tel: 415/558-8044
e-mail: sales@ranch-systems.com
website: www.ranch-systems.com.

PLEASE SEE RANCH SYSTEMS AD, PAGE 51.

Kendall-Jackson Nursery

Kendall-Jackson Wine Estates raised the bar of nursery quality when it opened an in-house nursery to customers throughout the industry. "The Madera, CA nursery has become one of the nations largest grapevine resources since it opened in1993," says Ernie Bowman, nursery general manager.

"We do things our own way from start to finish because we are so focused on, maybe even a little obsessed with, quality," he adds. "Our quality is second to none in the industry."

The nursery has prized scionwood cuttings from some of California's choicest vineyards, including those on Mt. Veeder in Napa County, and Alexander Mountain Estate in Sonoma County.

One key to quality at the nursery is a trellised rootstock block. Trellising, the exception rather than the rule at most nurseries, gets the rootstock off the ground for ideal sun exposure, reduces pests and fungus pressures, and encourages straight cuttings for grafting.

Vines are custom-cultivated to meet various requirements in terms of disease resistance, vigor, and drought tolerance. Dormant benchgrafts, dormant rootings, green benchgrafts, and green quick-starts are available. The nursery accepts custom orders and offers free delivery for orders of more than 10,000 vines.

Additional information about the nursery and its products is available at the Kendall-Jackson website: www.kj.com.

For more information, contact:

Kendall-Jackson Nursery
Ernie Bowman, General Manager
1190 Kittyhawk Blvd., Santa Rosa, CA 95403
tel: 707/836-2021; fax: 707/836-2266
website: www.kj.com

PLEASE SEE KENDALL-JACKSON NURSERY AD, PAGE 44.

Bird Gard/JWB Marketing, LLC

The Mega PRO has 120 decibels of output and covers 30 acres. It's 60 times more powerful than the Bird Gard Super PRO II that covers up to six acres. Included with the mega PRO is a 200-watt amplifier, a 20-speaker tower, and a 40-watt solar panel. List: $3,000; Discount: $2,400.

What vineyard managers say about the Mega PRO:

"Had the starling flocks been there, we would have lost $20,000 to $30,000 worth of grapes." Jack Keller, Hazlitt 1852 Vineyards, New York.

"All the birds just left ... no birds retrurned. We even stopped using the cannons. The Mega PRO really did a great job." Bob Kidston, Dykeview Farms, Nova Scotia.

"The Mega PRO paid for itself the first season because of the money we saved on bird patrols and pyrotechnics." Daryl Salm, Valley Farm Management, California.

For more information, contact:

Bird Gard/JWB Marketing, LLC
Jim Burton
2308 Raven Trail, West Columbia, SC 29169
tel: 800/555-9634; fax: 803/796-0654
website: www.birddamage.com

BioOrganics, Inc.

When a new vine is planted, there is an opportunity to introduce beneficial microbial organisms, particularly mycorrhizal fungi.

Grapes have evolved a natural dependence on mycorrhizae for obtaining nutrients and moisture. A vine with the right type of "friendly fungus" on its root system can uptake 10 to 50 times more nutrients, while a new vine without the fungi may struggle just to survive, especially in low-fertility soils. Synthetic fertilizers cannot duplicate the effects of mycorrhizae.

The helpful fungi also serve in a protective role by forming a physical barrier with their sticky hyphae. This wards off harmful root pathogens, such as nematodes, and many disease organisms.

The use of mycorrhizal inoculant on new plantings is now a common practice among progressive vineyards, and the BioOrganics Company has been a leading industry source for ten years.

Key points to consider when selecting an inoculant are species and spore-count guarantees, plus shelf life and cost. All BioOrganics inoculants feature multiple types of spores, including some that were top-rated in USDA grapevine trials. Either root dip or OMRI-listed powder is available, with quick UPS delivery to the grower's door.

For more information, contact:
BioOrganics, Inc.
53606 Bridge Dr., La Pine, OR 97739
toll free: 888/332-7676; fax: 541/536-1583
website: www.bio-organics.com

PLEASE SEE BIOORGANICS AD, PAGE 50.

The Olive Grove Nursery

Although the name is new, The Olive Grove Nursery's experience goes back to 1965, with on-site transplanting of giant old olive trees at Cribari Winery (south of San Jose, CA).

The Olive Grove Nursery has moved and transplanted over 30,000 old, mature, olive trees, throughout California. The Olive Grove Nursery provides both young and giant old, Spanish variety olive trees to vineyards as far away as Connecticut, British Columbia, Arizona, and Texas. Kalamata and Tuscany varietals have become a favorite with those planning on pressing or curing their own olives. The Olive Grove Nursery has trees from three to 100 years of age.

Since 1974, Olive Grove Nursery has provided many stately old olive trees to vineyards, wineries, movie sets, and private residences in Napa and Sonoma counties. Recently, competitors have submitted orders to supply olive trees to their homes or relatives' homes, showing that years of experience and quality trees make a difference to them.

While specializing in olive trees, other large boxed and field-grown specimens are available and on-site digging and transplanting of existing trees can be provided.

If quality and experience is important to you, contact The Olive Grove Nursery for large, field-grown olive trees.

For more information, contact:
The Olive Grove Nursery
PO Box 659, Palermo, CA 95968
tel: 530/533-8811; fax: 530/533-8817
e-mail: olivetrees@jps.net
website: www.olivetreemover.com

PLEASE SEE THE OLIVE GROVE NURSERY AD, PAGE 18.

Picovale Services, Inc.

Picovale Services is a consulting firm specializing in accurate data collection and dissemination for the agricultural community. The sole business function is to provide clients with meaningful data at a reasonable cost.

Picovale Weather Services

Picovale weather monitoring and alert services provide highly accurate real-time weather information at an amazingly affordable cost. The systems feature direct satellite communication and solar power, allowing the weather stations to be placed anywhere in a field where there is a clear view of sky. No user infrastructure is required!

The Picovale online web interface provides the mechanism to retrieve real-time weather information and includes various models for pest, irrigation, and disease management. Additionally, there is an interface to provide alerting capabilities when critical weather thresholds are met. (To see a demo, go to www.picovale.com; member login: guest; password: guest.)

Picovale weather monitoring and alerting services can provide your organization with solid, secure weather information when critical business decisions need to be made.

Picovale Data Services

Picovale Data Services provides solutions for a broad range of remote monitoring and control applications. As with the weather services, the online web interface provides the mechanism to remotely control valves, pumps, wind machines, and other devices. Remote soil moisture, water flow, tank/reservoir level, and gate/door position monitoring are available.

For more information, contact:
Picovale Services, Inc.
461 Grass Valley Hwy., Ste. 15
Auburn, CA 95603
tel: 530/ 889-8845; fax: 865/251-9117
e-mail: sales@picovale.com
website: www.picovale.com

PLEASE SEE PICOVALE SERVICES AD, PAGE 57.

PWV BOOKSHELF

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Chemical Analysis of Grapes & Wine: Techniques & Concepts (2004)
P. Iland, N. Bruer, G. Edwards, S. Weeks & E. Wilkes
Comprehensive theory and practice of major chemical analyses of grape and wine.
115pp—$110.00

Cooperage for Winemakers
Geoffrey Schahinger, Bryce Rankine
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edited by Nicholas, Margarey, Watchel
Dept. of Primary Industries & Resources, South Australia **106pp—$40.00**

Diseases, Pests, & Grape Disorders Field Guide
Magarey, MacGregor, Wachtel, & Kelly
Sturdy, laminated, pocket-sized guide containing more than 350 color photos with short, easily-read descriptions of most diseases, pests, and disorders found in vineyards.
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Peter May
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450 pages including photos
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B. Zoecklin, K. Fugelsang, B. Gump & F. Nury
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Guide to growers and vintners making decisions about variety plantings and growing practices.
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Wine Growers Guide Philip Wagner
Easy to understand essentials to establish a vineyard, pruning, training, vineyard management, propagating vines, and vine ailments.
229pp—$19.95

Wine Microbiology Ken Fugelsang
Provides background information, step-by-step laboratory procedures, and interpretation of results. **245pp—$95.00**

Winery Utilities Planning, Design, and Operation David Storm
Describes major components of winery utility systems for planning, design, and operation.
550pp—$115.00

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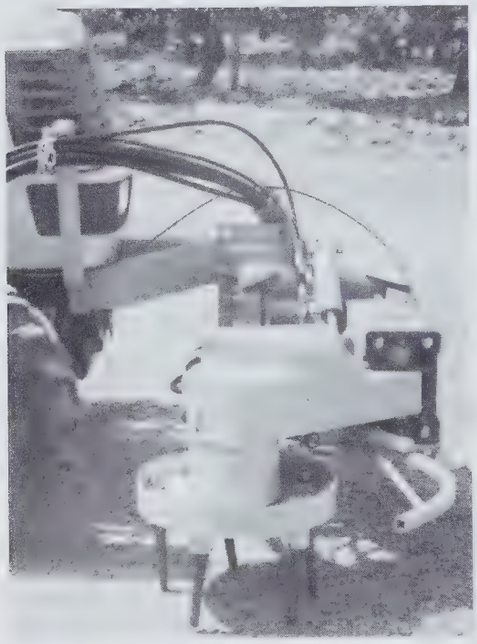
J. Chapman, P. Baker, & S. Wills
Examines the chemical nature of wastewater, its impacts, how it can be handled efficiently, and disposed of responsibly. **128pp—$21.00**

Kimco Manufacturing, Inc.

Now that the vineyard industry has made a turn toward better returns to the grower, this is a good time to evaluate methods to sustain profitability. A consideration of mechanical in-row weed control is valuable. Both in-row tilling and in-row mowing are cost-effective alternatives to the use of chemicals.



The Kimco Model 9300 is a heavy duty in-row tiller that works in soil and weed conditions that other in-row machines cannot handle. The Kimco can work in soils from sand to clay to rocks and in any combination. Weeds from just-emerged to six feet high are no problem.

The Kimco is mounted ahead of the operator, either in front or on the side of a tractor, for better visibility and ease of control. The operator can easily override the automatic vine sensor if desired. The Kimco Model 9300 in-row tiller and its companion model M-9700 in-row mower are proven to be very cost-effective in controlling weeds in the vine row.

For more information, please contact:
Kimco Manufacturing, Inc.
9200 W. Barstow Ave., Fresno, CA 93722
tel: 559/277-9300; toll free: 800/356-9641;
fax: 559/277-9358
e-mail: sales@kimcomfg.com
website: www.kimcomfg.com

PLEASE SEE KIMCO MANUFACTURING AD, PAGE 50.

Joseph W. Ciatti Company, LLC

The Joseph W. Ciatti Company, LLC is the wine industry's oldest, largest, and most comprehensive grape and bulk wine brokerage in the U.S. and internationally. Annual sales are over 110 million gallons (416 million liters).

Wine brokerage services include: grape contracts; grape processing contracts; complete negotiations of bulk wine purchasing and sales; tasting, blending, and finishing wines by on-staff enologists; objective information, including comprehensive long-term market analysis; evaluation of inventory quality and current market values; and locating unlabeled case goods or wine for private labeling.

The Ciatti Company has the most extensive and up-to-date product line of premium varietals; generic wines; grape and fruit concentrates; brandy and high proof from grape, citrus, and grain.

Internationally, Ciatti can broker exports of U.S. wines to overseas markets and import foreign wines to California labels and wineries, including wines from Australia, Chile, France, Argentina, and other major wine growing regions including South Africa.

Joe Ciatti, John Ciatti, Greg Livengood, and John White specialize in premium coastal varietals and share responsibility for all California wineries. Chris Welch is responsible for ultra-premium wineries in California. Chris Braun, Daniel Murphy, and Dennis Schrapp cover international markets and wineries outside California. Glenn Proctor and Johnny Leonardo are responsible for brokering grapes and assist with California wineries. Andy Bivona and Greg Magill specialize in varietal juices and concentrates, beverage alcohol, and all natural grape colors.

For more information, contact:
Joseph W. Ciatti Company, LLC
1101 Fifth Ave. #170, San Rafael, CA 94901
tel: 415/458-5150; fax: 415/458-5160
e-mail: reception@ciatti.com
website: www.ciatti.com

PLEASE SEE JOSEPH CIATTI CO. AD, PAGE 9.

Agri-Analysis, LLC

Agri-Analysis is a diagnostic laboratory where assays are performed to detect the presence of a variety of grapevine pathogens. Highly sensitive and specific assays are utilized to detect viral, bacterial and fungal pathogens in vine tissue, graft union, and root samples.

Agri-Analysis

Information provided by these assays helps nurseries and growers select the best material suitable for propagation. Laboratory confirmation of field-diagnosed problems provides verification that the problem is not related to nutrient deficiencies.

A Standard Combination Panel assay will detect the most economically important grapevine pathogens: grapevine leafroll associated virus types 1, 2, and 3; grapevine fanleaf virus, GVB, and Pierce's disease. A wide range of additional assays will detect other viruses that occur in vines, such as Red Globe virus, Fleck, and other leafroll-associated viruses. The Extensive Panel will test for all 14 viral and bacterial pathogens in the Agri-Analysis repertoire.

Pierce's disease is an increasing concern to growers. The Agri-Analysis laboratory offers a selection of two assay methods of detecting *Xylella fastidiosa*.

Diagnostic tests for suspected fungal diseases such as oak root fungus, *Phytophthora* spp., *Eutypa*, and fungi associated with vine decline (*Phaeoacremonium, Phaeomoniella,* and *Cylindrocarpon*) can be performed by qualified, experienced personnel.

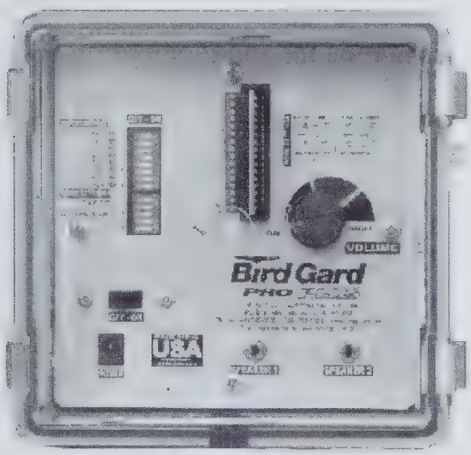
For more information, contact:
Agri-Analysis, LLC
45133 County Rd. 32B, Davis, CA 95616
tel: 530/757-4656; fax: 530/757-4655
e-mail: agrialys@yvm.net

PLEASE SEE AGRI-ANALYSIS AD, PAGE 52.

Bird Gard, LLC

Bird Gard® electronic bird repelling products drive unwanted birds away from vineyards, orchards, crops, and anywhere birds are a problem. Audible bird distress and harassment sounds combined with predator sounds such as hawks and falcons are digitally-recorded onto microchips. These sounds are then amplified and broadcast to protect areas up to 30 acres (12 hectares) in size.

Bird Gard products are effective against starlings, robins, grackles, seagulls, woodpeckers, and many other pest birds.



The new Bird Gard Pro Plus and Bird Gard Super Pro models are fully digital, include all random operation throughout, including randomly generated sounds, speaker operation, and sound frequency variations, minimizing bird habituation.

All systems are backed by a one-year satisfaction guarantee, are weather and UV-resistant, and are manufactured in the U.S.

For more information, contact:
Bird Gard, LLC
PO Box 1690, Sisters, OR 97759
tel: 541/549-0205 or toll-free: 888/332-2328
fax: 541/549-5286
e-mail: info@birdgard.com
website: www.birdgard.com

California Grapevine Nursery, Inc.

California Grapevine Nursery, certified by the California Department of Food & Agriculture, provides grape-growers with high-quality planting materials. Available products include dormant rootstock and dormant grafted vines, at very competitive prices.

California Grapevine Nursery

Choose from 21 varieties of certified rootstock including the French-developed Gravesac variety. A large selection of scion varieties and clones, including ENTAV-INRA® clones to customize your grafted-vine order, is also available. California Grapevine Nursery is a licensed agent of ENTAV-INRA® material in the U.S. with authentic clones from France.

California Grapevine Nursery employs state-of-the-art nursery practices to assure clean, healthy, and productive grapevines. An integrated pest-management program is utilized to carefully monitor vines and treatments are applied only when absolutely necessary. An integrated fertilization program provides vines with proper nutrition along with preplant soil conditioning. All vines are hot water treated at no extra charge.

California Grapevine Nursery is dedicated to providing customers with the highest quality plants available and excellent, efficient customer service.

For more information, contact:
California Grapevine Nursery, Inc.
1085 Galleron Rd., St. Helena, CA 94574
tel: 800/344-5688; fax: 707/963-1840
e-mail: sales@californiagrapevine.com
website: www.californiagrapevine.com

PLEASE SEE CALIFORNIA GRAPEVINE NURSERY AD, PAGE 36.

Jim's Supply Company, Inc.

Jim's Supply Company, Inc., one of the largest and oldest full-service national suppliers of trellising products, is one of the best partners you can have in the successful installation of your vineyard. In business since 1959, Jim's Supply manufactures metal products including stakes, posts, crossarms, and braces, including the signature Superstake Grande, Rolled Edge Vertical Grapestake, and Spaded Drill Pipe End Post that are a standard in vineyard trellising. **Buy direct and save!**

Jim's Supply Company, Inc.

Bird netting supplies, both extruded and woven-style netting, are offered.

Jim's Supply is a leading distributor of quality brands such as Davis Wire, Preformed Vineline, Minuteman, Powder River, and Gripple.

Call to discuss vineyard planning for the best quality and quantity output at the best prices. Jim's Supply can custom-design and manufacture a system for specific needs. Salesrooms are in Calistoga and Bakersfield, CA, where you will find what you need in a more than 10-acre facility or call 800-423-8016 from anywhere in the U.S. to find out how to optimize your canopy management and order vineyard products.

For more information, contact:
Jim's Supply Company, Inc.
3530 Buck Owens Blvd., PO Box 668
Bakersfield, CA 93302
tel: 661/324-6514 or 800/423-8016
fax: 661/324-6586
4102-A St. Helena Hwy.
Calistoga, CA 94515
tel: 707/942-JIMS (5467); fax: 707/942-9752
Fresno, CA: 559/930-6165
Monterey, CA: 661/978-9385
Central Coast: 661/324-6514
e-mail: jimssci@jimssupply.com
website: www.jimssupply.com

PLEASE SEE JIM'S SUPPLY CO. AD, PAGE 24.

Advanced Viticulture

Advanced Viticulture LLC is a winegrowing consulting service for wineries, winemakers, and winegrowers who are dedicated to producing premium wines. Advanced Viticulture is operated by Dr. Mark Greenspan with 17 years of scientific research and viticultural experience, and specializing in irrigation and nutrition management, yield and canopy management, vineyard climate, fruit maturation, and viticultural technologies.

ADVANCED VITICULTURE
TECHNOLOGY FOR WINEGROWING

Services include, but are not limited to:

1. Winery/winemaker to grower liaison: Achieving wine quality targets through best viticultural practices and vineyard uniformity and quality assessments.
2. Irrigation Management: Strategies, Monitoring, and Scheduling for superior wine quality.
3. Mineral Nutrition: Avoid or identify and correct deficiencies without getting vines out-of-balance.
4. Yield and canopy management for ***uniformity*** of ripeness and character.
5. Viticultural Technologies: GIS, GPS, Canopy Density Mapping, Precision Viticulture, and Moisture Monitoring systems.
6. Maturity Assessment: Harvest at ***true*** ripeness!
7. On-site research experimentation: Learn what works best for ***you*** at ***your*** site.
8. Weather and climate evaluations: Vintage evaluations and vineyard preplant planning.

For more information, contact:
Advanced Viticulture
Mark Greenspan
tel: 707/568-5256
e-mail: mark@advancedvit.com
website: www.advancedvit.com

JMS Flower Farms, Inc.

JMS Flower Farms, Inc. offers JMS Stylet-Oil and Organic JMS Stylet-Oil to winegrape growers. The food-grade white oil formulations are valuable tools for growers interested in economical, effective pest control in the vineyard.

Organic JMS Stylet-Oil is approved for organic use and is OMRI-certified. Both products, referred to as "Stylet-Oil" control powdery mildew and Botrytis. Working as an eradicant and preventative, Stylet-Oil kills powdery mildew on contact and maintains control in a 10 to 14-day spray interval.

University-tested on grapes for 14 years, Stylet-Oil is recognized by leading researchers, including Dr. Doug Gubler, UC Davis, and Dr. Wayne Wilcox, Cornell University (NY) as one of the best eradicants on powdery mildew and one of the few "soft" materials to control powdery mildew. Stylet-Oil can replace sulfur sprays for powdery mildew control. A 4-hour reentry interval and 0 days pre-harvest interval, allows workers to safely reenter the vineyard quickly. Workers enjoy no sulfur irritation.

Stylet-Oil controls plant-feeding mites, mealybug, scale, and leafhoppers. Stylet-Oil is tank-mixable with most fungicide, insecticide, or foliar sprays (10-day interval with sulfur and 14 or more with Captan), allowing flexibility in integrating this material into your spray program. While effective on a broad range of pests, Stylet-Oil is not harmful to populations of beneficial insects. Economical and biodegradable, Stylet-Oil is a plus for grape growers seeking safe, effective pest control programs.

For additional information on the product or to find a local dealer in your area, visit the website: www.stylet-oil.com.

JMS Flower Farms, Inc.
4423 5th Place SW, Vero Beach, FL 32968
tel: 772/562-8770; fax: 772/562-7202
e-mail: styletoil@aol.com

Kinsey Agricultural Services, Inc.

Utilizing GPS technology combined with detailed soil analysis, a consulting service is offered that can correctly determine nutrients required for each significant variation in the soils of every vineyard. This technology is used to correctly measure, map for sampling, and analyze quality of vineyard soils. By understanding the subtleties of each different soil and consequences that nutrient deficiencies or excesses will cause in those soils, potential problems can be identified and appropriate solutions proposed.

Plant tissue analysis is optional, for use in conjunction with soil testing to monitor progress and specific nutrient needs of a vineyard. Whether compost is used in conjunction with other fertilizers or not, a compost analysis can help assess the consequences of use on each different area of the vineyard. This also requires proper soil evaluation and accurate recommendations to avoid problems from applying too little or too much.

By using detailed measurements and specifically formulated procedures for controlling both excesses and deficiencies in soils, it is possible to define, measure, and manage soil fertility to help grow high quality grapes. On-site consultations can be arranged to help assure growers achieve/maintain established goals.

Optional training programs help clarify soil fertility requirements. Programs on building and maintaining vineyard fertility are conducted periodically for grapegrowers as posted on the www.kinseyag.com website.

Overall client satisfaction, improvement of soil nutrient levels, and resulting high quality grapes provide the underlying support for use of the Kinsey program.

For more information contact:
Kinsey Agricultural Services, Inc.
297 Co. Hwy. 357, Charleston, MO 63834
tel: 573/683-3880; fax: 573/683-6227
e-mail: neal@kinseyag.com
website: www.kinseyag.com

May 25
Variety Focus: Grapes of the Rhône
Freeborn Hall, UC Davis

Origins of the Rhône varieties will be examined; their role in the regional wines of the area; their history in both France and the new world; the importance, development, and selection of clones; and the role of terroir in vine performance. Up-to-date information will be provided about well-known Rhône varieties (Syrah, Viognier, Mourvèdre, and Grenache Noir), and minor varieties including Cinsault, Picardin, Clairette, and Mucardin.

Dr. Deborah Golino, director of Foundation Plant Services (FPS), UC Davis, will present an overview of the winemaking history of the Rhône and the important role that regional varieties have played, availability of Rhône varieties in the U.S. and a new project, a joint venture between Tablas Creek and FPS to import additional Rhône varieties.

François Perrin (a partner in the Tablas Creek project in California and member of the Perrin family that is in its fifth generation of ownership at Château de Beaucastel, widely recognized as one of Châteauneuf-du-Pape's finest *domaines*), will review performance of 13 Châteauneuf-du-Pape varieties at Château de Beaucastel. A tasting of Beaucastel wines will accompany the discussion.

Glenn McGourty (UC winegrowing and plant science advisor, Mendocino and Lake Counties), will offer data and observations from trials with Grenache, Syrah, Mourvedre, Cinsault, Marsanne, Viognier, and a Syrah clonal trial; sharing experiences working with these cultivars in terms of their strengths and quirks, presenting vine performance data for three years at the Red Hills Trial in Lake County, and five years from UC Hopland Research and Extension Center.

Wayne Farquhar will discuss the Australian Shiraz (Syrah) vine selection program and performance of some Australian Shiraz clones now available in California in "Syrah clonal selection and evaluation in Australia." Wayne is the executive officer of the South Australian Vine Improvement Incorporated (SAVII). At SAVII, he has been responsible for development of a rapid multiplication grape vine nursery and establishment of a clean stock program for the Australian wine industry and project leader of the SAVII grapevine variety selection and improvement program.

John Buechsenstein, winemaker, wine educator, and Rhône Ranger, will discuss vinification schemes for production of rosé with Rhône varieties in his talk "Elaboration of Rosé." (A tasting is included.)

Final presentation and tasting of wines will feature Rhône varieties by Robert Haas, General Partner, Tablas Creek Vineyard. He is an experienced importer, vintner, and member and past president of the Académie Internationale du Vin. He will talk about Rhône varieties available in California, current and future; their appropriateness for California climate and soils; reasons for blending several varieties together; and marketing questions about blends.

$210 fee includes course materials, lunch, and all tastings. For more information or to enroll, call: 800/752-0881, email: aginfo@unexmail.ucdavis.edu or visit www.extension.ucdavis.edu/winemaking.

June 26–30
ASEV 57th Annual Meeting

The American Society of Enology & Viticulture (ASEV) Board of Directors has a three-year strategic plan to enhance the content of its June Annual Meeting in Sacramento, CA.

One important 2006 enhancement will be topic-specific modules. Invited speakers will address both the history of a topic and describe existing science and technology. This overview should bring all members and guests up to date and provide a platform for scientists to present new advancements, discoveries, and science regarding that topic.

"Our members and guests want to keep up with the advances in science and technology, but many do not have the time or resources to continue their education," explains Patricia Howe, ASEV program chair. "The modules can meet these members' needs by bringing us all up to speed."

A second benefit is that modules allow the ASEV to target key researchers in specific areas and become keystones upon which the ASEV will build new research forums.

Two modules will be presented, with more under consideration:

Grape Crop Estimation, with particular relevance after the 2005 harvest, will review current practices, their shortcomings and strengths, and what factors are known to influence their performance. New techniques in use or in development will be presented, and the science and technology explained. John Cole (Kendall Jackson) is chair.

Advances in Microbiological Techniques, chaired by Dr. Charlie Edwards of Washington State University (WSU), will review advances in micro techniques, introduce basic PCR methods, current methods of microbial detection and what they mean, and current research in microbial identification.

Industry/Exhibitor Technical Programs

Another new component will be technical programs presented in conjunction with the Supplier Showcase. By combining presentations by suppliers and industry experts on the trade show floor, the ASEV offers a comprehensive Supplier Showcase experience. Technical programs will focus on day-to-day problems encountered by industry members and emphasize increasing understanding of technologies and problems inherent to production.

"We believe it's vital to help ASEV members harness the significant knowledgebase of exhibitors," Howe says. Topics include: *Issues in Bottling* and *Issues in Oak Usage*, with potentially more programs.

Research Forums

Research Forums, providing for discussion and interaction on many research issues, will be limited to researchers in a particular area; interactive roundtable discussions to assist and enhance research. Summaries of issues encountered or key points will be presented to the general audience on June 30. Forums include: phenolic methods, crop estimation, wine and grape aroma, and microbiological genetics.

Seminars and Symposia

Terry Acree of Cornell University (NY) is organizing an Aroma Symposium, to address wine and grape aromas from the aspects of neurological perception, underlying chemistry, and viticultural and enological influences on their development.

An Experimental Design Seminar will address useful statistics and issues in designing trials, critically assess designs in the literature and give examples of good designs. Organized by Tom Collins (Foster's Wine Estates) and John Thorngate (Beam Wine Estates), speakers are: Hildegarde Heymann, Linda Bisson, Mark Matthews, and Sue Ebeler (UC Davis); Thomas Henick-Kling (Cornell); Cristina de la Presa Owens (Fosters); Jeffri Bohlscheid (WSU), and Stan Howell (Michigan State).

Collins and Thorngate have organized an SO_2 Seminar to address chemical and microbiological effects of SO_2, compliance issues, and specific methods. Speakers are: Art Caputi (Art of Winemaking); Jeannie Bremer, Andrew Waterhouse, and Roger Boulton (UC Davis); Andrea Verari (University of Bologna), and Sarita Cardoza (Tax & Trade Bureau).

More information will be posted on the ASEV website at www.asev.org, where guests can register for the 57th Annual Meeting.

July 7–9
Zinposium

Masters of Zin Forum: A forum for wine industry professionals, sommeliers, retailers, wholesalers, restaurateurs, and wine educators interested in developing a greater knowledge of Zinfandel. Produced with assistance from the Sonoma State University Wine Business Program.

Friday, July 7

3 PM: This is Zin — Zinfandel Basics. Includes tastings to demonstrate different wine styles and flavors, along with simple food pairings to highlight typical Zinfandel characteristics. Information to be provided to participants with questions scattered throughout to test their understanding as a first step towards the Zin Master certificate. Presentation topics will include: History / Origin of Zinfandel; Attributes / Characteristics of the grape; Regional growing areas and terroir impact; Efforts to preserve Zinfandel greatness through the Heritage Project and ZAP.

Continued on page 86

PERSONNEL POINT OF VIEW by Shelley Brott

Leading through change

"Nothing endures but change." Heraclites, in the late 6th Century BCE, may have been the first to make this observation but he certainly wasn't the last. Change is the status quo, and yet for most of us it's still not easy to deal with.

Whether it's implementing a new point-of-sale system in a tasting room, revamping bottling procedures, carrying out a major reorganization, or integrating post-acquisition processes, all changes, big or small, require thoughtful leadership to be successful. Let's look at some useful tips to keep in mind as you steer your ship through the stormy seas of change.

EMBRACE CHANGE. DON'T RESIST. This is sometimes a lot easier said than done, especially if you'll be impacted personally by the change. Do what you can to build your own resilience and flexibility. These characteristics will help you adapt to the new situation more quickly.

Diane Coutu at *Harvard Business Review* has researched the importance of resilience in successful people. She identified three fundamental characteristics that seem to set resilient people apart from others:

"The first characteristic is the capacity to accept and face down reality. In looking hard at reality, we prepare ourselves to act in ways that allow us to endure and survive hardships. Second, resilient people possess strong values and an ability to find meaning in some aspects of life. The third building block of resilience is the ability to improvise. Within an arena of personal capabilities, the ability to solve problems without the usual or obvious tools is a great strength."

DEMONSTRATE A POSITIVE, HOPEFUL, FUTURE ATTITUDE. As a leader, you will likely be in a position to communicate organizational decisions and the changes that result. You will probably be asked to field questions and concerns. You may also have questions or concerns of your own. This is an area where you can truly "lead by example." Others will listen closely to what you say and the attitude you portray.

Do you pass the buck — "This wasn't my idea" — or condemn and criticize — "I don't know what they were thinking?" Or do you look for ways to express support and accountability for the decision and the process — "Let me see what I can find out," "This couldn't be done and here is why," "I'm sure we can work this out." Sometimes you can't satisfactorily resolve every issue or concern, but a positive willingness to explore issues and gather information can go a long way to bring people on board.

PROVIDE CLEAR FOCUS AND GUIDANCE. It's helpful to keep people focused on the future and what the changes will mean for them, rather than dwelling on what will be lost. In the midst of uncertainty, people tend to cling to what was familiar. Paint as clear a picture as possible of what the future will look like. If the change will result in the improvement of a process or situation, remind people of their previous concerns and the expected benefits. Get them involved in creating and implementing the future.

It's also important to keep everyone focused on the task at hand. When people are busy and feeling productive, they are less likely to dwell on the uncomfortable unknowns of the future.

SEEK RESISTANCE, FEELINGS, AND QUESTIONS. Ask people how they are feeling — especially those individuals who may be having a hard time. This may seem counter-intuitive. You may be saying to yourself "What I don't know can't hurt me" or "Why stir things up." The truth is that these individuals, while they may not be talking to you, are most likely talking to everyone else on the team.

You need to know what their concerns are, so you can address them with the facts. You may not be able to satisfy them, but you will be able to show that you care about them and are willing to talk about their concerns. Even if they aren't happy with your efforts and the result, others will see that you're accessible and open to hearing their feelings. This will help you gain credibility and support.

INCREASE RECOGNITION AND PRAISE. In times of uncertainty and change, many people are visited by their inner critics, who stir up self-doubt. Past mistakes are magnified, self-confidence is dashed. This can be very difficult, for two reasons. First, it can affect team productivity during the change implementation. Team members can become overly cautious or overly sensitive. Working relationships can become competitive and strained. Second, it can affect the team's willingness to take the risks necessary to learn new things. This can severely impact a team's ability to put new procedures or processes into place.

To counteract this situation, it's important to ensure that people know that they're competent and effective at their current jobs, and that they have the capacity to implement changes required for the future. Step up the recognition. Let everyone know when they're meeting or exceeding your expectations. Acknowledge the difficulty and effort required to maintain "business as usual" during the change implementation. You will be rewarded with loyalty and increased enthusiasm.

PAY CLOSE ATTENTION. INCREASE CHECK IN. Remember "Management by Walking Around?" It may seem like a tired management theory, but it's still as relevant as it was in 1982, when Tom Peters and Bob Waterman popularized Hewlett-Packard's mantra in their bestselling book *In Search of Excellence: Lessons from America's Best-Run Companies.*

Especially in times of change, talking to people on a regular basis is the best way to "take the pulse" of the organiza-

tional climate. Don't ask them to come to you. Don't wait for a staff meeting. Put processes in place to ensure that people know you're accessible. Walk through the cellar or the tasting room. Ask questions via email. Talk to people as they're doing their work. Give them every opportunity to let you know how they're doing. Give yourself an opportunity to observe for yourself how they're doing.

In addition to getting a read on morale, you'll also be able to judge how well the change implementation is going. People may not be willing to tell you that there's a problem, but you may be able to see a bottleneck or observe excessive confusion, if you're out on the floor.

OVER COMMUNICATE. There is an old maxim taught by professional speakers: "Tell them what you're going to tell them, then tell them, and then tell them what you told them." This is also true during times of change. Communicate. Communicate. Communicate. You can't do too much.

Remember to use different communication styles as well. Some people will prefer meetings, some memos or newsletters, and others will prefer one-on-one discussions. Provide a variety of methods for people to hear what's going on and respond to it.

PROVIDE LEADERSHIP. Last but not least, step up to the plate and be the best leader that you can be. If you have questions about what to do, ask your boss or a mentor. Look on the Internet for ideas. Talk to a consultant or a coach. People in your organization are looking to you to guide them through the change process and lead them to the future on the other side.

If you wish the changes in your organization to be well managed and positive for both employees and the company, you must look to yourself as the champion of that outcome. As Mahatma Gandhi said, "We must be the change we wish to see in the world." If you use these tips, you'll be well on your way to success. ■

Anne Heron is a Senior Associate with The Personnel Perspective, a human resources consulting, training, and recruiting firm in Santa Rosa, CA. Anne has over 25 years of management and HR experience. You can contact her at 707/576-7653.

CLASSIFIED AD

Research Director

The California Department of Food and Agriculture (CDFA) is seeking a motivated, innovative outside consultant to serve as Research Director for the CDFA Pierce's Disease and Glassy-winged Sharpshooter Board. Please refer to contract number "RFP #05-0616" at https://www.cscr.dgs.ca.gov/cscr/ for more information. Contact: Ms. Joy Mountjoy mountjoy@-cdfa.ca.gov; ph: 916-651-8182).

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Getting savvy about Sauvignon Blanc...

Have you noticed recently how the Kiwis (New Zealanders) are getting so "proudy" about Sauvignon Blanc? I suppose with good reason, since their wines are regarded by most independent commentators as the equal of, if not superior to, those from the Loire in France or any others in the world.

This is a good effort, as it has been less than 30 years since the Sauvignon wines from New Zealand appeared on the world scene. By the way, and please forgive me for this digression, but I want to correct a bad English habit. The correct variety name is ***Sauvignon***, not ***Sauvignon Blanc***. The "Blanc" part (French word for white) is unnecessary. (It is a bit like saying Cabernet Sauvignon Noir, or black. Can we agree to drop the "Blanc"? Hereafter, I will refer to it as *Sauvignon*.

I worked in New Zealand in the early 1980s when there were few vineyards in Marlborough on South Island. The little town of Blenheim was agriculturally based, with sheep farming, kiwi fruit, cherries, and a few vineyards. Now it is a thriving wine town and tourist destination, with a valley floor covered in vineyards, exorbitant land prices, potential water shortages, and a great international reputation to boot.

Why is this? Frankly, the wines there are exceptional. Montana Winery founder Frank Yukich planted Sauvignon among other varieties in his early vineyards near Blenheim, but it was Ernie Hunter of Hunters Wines (Wairua Valley, Marlborough) who brought Sauvignon to the world's attention, when he won the London International Wine Competition for his Marlborough Sauvignon in the early 1980s. The rest is history, as they say, although it took another 15 to 20 years of hard work to truly establish the region.

Growing great Sauvignon

Why is Marlborough Sauvignon so good? Undoubtedly and primarily, it's because of the temperature conditions there, plus something to do with sunshine and humidity. A good question is: are there similar conditions elsewhere in the world? Yes, I can identify such spots in the U.S. and Australia — California and Tasmania, among others — using precise, computer-based temperature matching homoclime studies. I suspect that ultra violet sunshine has a particular role to play, and in that regard, Tasmania likely has some advantage over northern hemisphere regions.

As important as vineyard climate is, there is more to growing great Sauvignon. I was reminded of this when I attended the fantastic Lake County Sauvignon (Blanc) Conference. There was an international group of Sauvignon devotees, producers, and consumers, spending a couple of days in earnest learning in March 2005.

Interestingly, this conference came just one week after the harvest of Sauvignon at Tamar Ridge, Tasmania, which I described in my last column (January/February—2006). To summarize that column, we had identified that low-vigor vines had low yields (expected) but no discernible fruit flavor (unexpected) compared to the Scott Henry-trained Sauvignon vines with higher vigor and yield.

The low-vigor vines showed signs of prior water stress and nitrogen deficiency, which were confirmed by tissue tests. Both of these stresses could be associated with the cover crop in the vineyard, which had not been cultivated since it was sown about a decade earlier.

Those of you who have read my earlier columns will recall that I have stated that it is generally impossible to taste "wine" flavor in grapes. I have mentioned this in relation to "hang time" and "psychological ripening." However, for Sauvignon, tasting varietal character does seem possible.

Before leaving Tasmania, I wanted our Tamar Ridge enologist, Michael Foggarty, to give me a wine evaluation, but he said he could not. "I think the high yielding fruit has a better nose, but it has only been fermenting six days," he told me. So off I went to Lake County, with grape composition data, but only impressions of the young wine still bubbling in tanks in Tasmania.

Brilliant French studies

What a pleasure it was at the conference to hear papers from Xavier Chone and Christine Barbe about French studies with Sauvignon. They had both been associated with the laboratory of Dr. Denis Dubordieu in Bordeaux, where significant research on Sauvignon flavors has been done. These studies have identified four aromatic thiol compounds associated with Sauvignon aroma. In the fruit, these aromatic compounds are present as precursors, which have no aroma.

The French study found that concentration of these precursor compounds in the fruit increases to a maximum, then decreases, so be careful not to give Sauvignon hang time! The concentration of flavor precursors was highest with a moderate water stress and adequate soil nitrogen. Too much water stress and nitrogen deficiency reduced the level of flavor precursors.

These studies confirm that Sauvignon flavors can be manipulated in the vineyard and during fermentation. Sauvignon flavors can also be tasted in the fruit

Nitrogen and water-stressed canopy of low-vigor vine, with two green leaves from high-vigor vine. Note that leaves on low-vigor vine are smaller, more yellow rather than deep green, and show burning due to water stress.

Conclusion

The French studies predicted our subsequent results from Tamar Ridge in Tasmania. Nitrogen and water stress had reduced the level of flavor compounds, as well as reducing vigor and yield. When we eliminated these stressors, we found that higher yielding vines produced better wine with more flavor. This wine went into a higher price-point bottling.

For Sauvignon, it is obvious that soil moisture and nitrogen have very important effects on flavor profiles. The New Zealanders are mounting a major research initiative to better understand Sauvignon flavors in Marlborough, so we can expect to learn even more about this in the future. ■

Dr. Richard Smart, "the flying vine-doctor," is an international viticultural consultant based in Launceston, Tasmania, in Australia. He can be contacted by e-mail: vinedoctor@compuserve.com. Read about Dr. Smart's business, including his consulting schedule, educational wine tours, and seminars, at his home page http://www.smartvit.com.au. He visits America frequently and his consulting schedule is arranged by Vinquiry in Windsor, CA, tel: 707/ 838-6312 and http://www.vinquiry.com.

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Vegetal Characters

Continued from page 20

tion, prior to veraison, can also be used to decrease vegetal characters.

It appears that MP synthesis is related to vegetative growth of grapevines, so any early intervention that decreases canopy size/leaf area also decreases pyrazine content in berries. There may be growing areas where some varietals can't achieve enological "ripeness," if the definition of ripeness includes absence of vegetal characters. But in most areas, manipulation of pyrazines in the vineyard is key to their expression in a resultant wine. ■

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Calendar

Continued from page 81

5:30 PM: Terroir and Zin Regional Tasting Walkabout. Printed program (passport) will include detailed information on the regions, wines tasted, and what makes them unique. Attendees will have the ability to work towards a Zin Master certificate by answering questions about each region and receive "stamps" on their passport.

SATURDAY, JULY 8

Seminar: State of Zinfandel Today. *Speakers:* Dr. James Wolpert, UC Davis Viticulture & Enology Dept.; Doug Frost, M.S., M.W., WineSight Technologies, and Wine Educator; Christian Miller, Full Glass Research; Moderator: Mack Schwing, Sonoma State University.

Winemaker Dinners: Various ZAP-member wineries and restaurants located within 30 minutes of The Meritage Hotel.

SUNDAY, JULY 9

Zinday in the Vineyard (vineyard visits).

Location: Meritage Hotel; Napa, CA.
Reservations online at www.zinfandel.org, or call: 530/274-4900.

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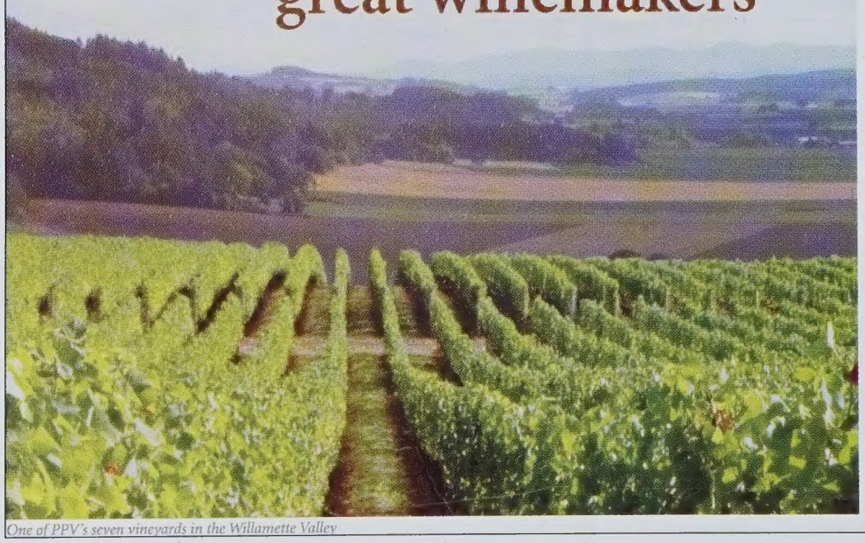

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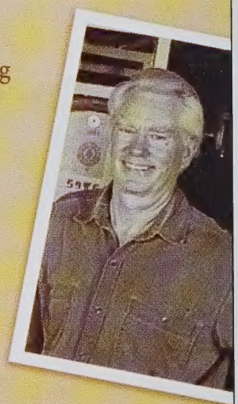

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Modular Information Systems	12	800-647-3757		sales@miscorp.com
Napa Fermentation Supplies	54	707-255-6372	707-255-6462	wineyes@aol.com
Nomacorc	16	707-746-5704	707-746-7471	info@nomacorc.com
Oeneo Closures USA	28	707-256-2830	707-256-2831	info@oeneoclosuresusa.com
Olive Grove Nursery	18	530-533-8811	530-533-8817	olivetrees@jps.net
OnTarget Spray Systems	31	831-595-9433	831-758-2110	ontarget@pacbell.net
Orchard-Rite™	33	509-457-9196	509-457-9186	sales@orchardrite,com
OXBO International Corp.	49	559-897-7012	559-897-9350	gberg@oxbocorp.com
The Personnel Perspective	12	707-576-7653	707-576-8190	infor@personnelperspective.com
Pickering Winery Supply	22	415-474-1588	415-474-1617	pickering@sbcglobal.net
Picovale Services, Inc.	57	530-889-8845	865-251-9117	john@picovale.com
Premier Pacific Vineyards	86	707-224-6565	707-257-2990	
Premier Power	69	877-939-0400		info@premierpower.com
Premiere Viticulture	49	707-261-8750	707-255-2044	steve@premierevit.com
Ranch Systems LLC	51	415-558-8044	415-520-6005	sales@ranchsystems.com
Refrigeration Technology, Inc.	54	800-834-2232	707-987-4581	sales@rti2000.com
St. Patricks of Texas	53	512-989-9727	512-989-8982	stpats@bga.com
Savour Oak	20	707-746-5704	707-746-7471	sales@newpakusa.com
Scott Laboratories	59, 85	707-765-6666	707-765-6674	info@scottlabs.com
Sierra Gold Nurseries	15	800-243-4653	530-273-1760	sierragold@sierragoldtrees.com
Spec Trellising	46	800-237-4594	215-357-3122	info@spectrellising.com
Spectrum Technologies	31	800-248-8873	815-436-4460	info@specmeters.com
Stoel Rives	60	503-294-9236	415-676-3000	crhermann@stoel.com
Summit Engineering	69	707-527-0775	707-527-0212	jane@summit-sr.com
Sunridge Nurseries	55	661-363-VINE	661-366-4251	bcrettol@sunridgenurseries.com
Terra Spase	53	707-967-8325	707-967-8596	terraspase@earthlink.net
Tonnellerie Boutes	45	510-799-1518	510-799-1557	boutesusa@aol.com
Tonnellerie Quintessence	41	707-935-3452		brian@tonnelleriequintessance.com
Tonnellerie Sirugue	58	310-452-8147	310-452-7847	siruguesa@earthlink.net
Turrentine Wine Brokerage	27	415-209-9463	415-209-0079	info@turrentinebrokerage.com
TW Boswell	17	707-255-5900	707-255-5952	info@twboswell.com
Vintage Nurseries	83	800-499-9019	805-758-4999	steve@vintagenurseries.com
Vineyard Industry Products	37	800-544-2210	707-431-0807	info@vineyardindustryproducts.com
Vinovation, Inc.	6	707-824-7900	707-824-7905	info@vinovation.com
Weedbadger	8	800-437-3392	701-778-7501	weedbadg@drtel.net
Western Square Industries	11	800-367-8383	209-944-0934	info@westernsquare.com
World Cooperage	88	707-255-5900	707-255-5952	info@worldcooperage.com

You are invited to Duarte's annual 'Friends Day', May 5, 2006

Tours - Wine Tasting - Trade Show - Lunch

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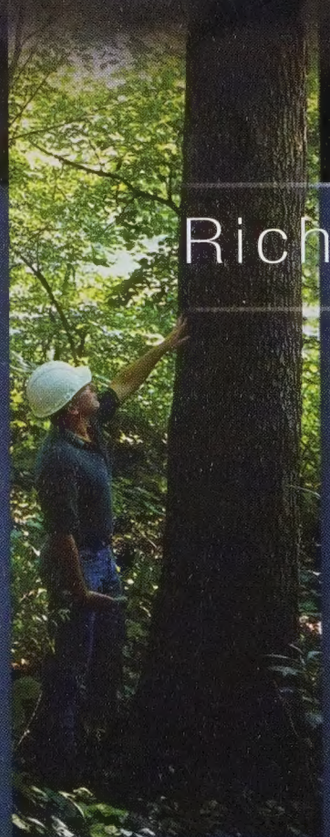

Richard nurtures his crop

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